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ABSTRACT

Begun on an experimental basis in March 1975, the ongoing PLATO project at the University of Delaware has become an established part of the University's academic program. This descriptive report is divided into three sections: (1) project history and development, including organization, utilization, instructor and author training, and projections for future growth; (2) departmental applications from 18 academic departments; and (3) project evaluation, including evaluation model, student questionnaires, controlled experiments, project reports, and overall educational value of PLATO for the university. Appended is a list of programs under development. (STS)

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Second Summative Report of the Delaware PLATO Project

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by

Fred T. Hofstetter

July 1, 1977

udplato

University of Delaware
PLATO Project

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TABLE OF CONTENTS

		Page
LIST OF TABLES		v
LIST OF FIGURES		vii
INTRODUCTION		1
Chapter		
I.	HISTORY AND DEVELOPMENT OF THE DELAWARE PLATO PROJECT	
	Background	2
	Utilization	3
	Organization	10
	Instructor and Author Training	14
	Lesson Review	16
	Participation in ADCIS	19
	Projections for Future Growth	22
II.	APPLICATIONS	24
	Agriculture	24
	Art	27
	Business and Economics	30
	Chemistry	31
	Communications	32
	Computer Science	33
	Continuing Education	33
	Counseling	33
	Education	35
	English	40
	Home Economics	41
	Languages	42
	Music	44
	Nursing	46
	P.S. DuPont High School	47
	Physical Education	49
	Physics	50
	Psychology	51
	Theatre	52
III.	EVALUATION	53
	Model for Project Evaluation	53
	Student Questionnaires	54
	Controlled Experiments	57
	Bi-Monthly Project Reports	60
	Overall Educational Value of PLATO for the University of Delaware	61

TABLE OF CONTENTS (Continued)

APPENDIX:

List of Programs Under Development in the Delaware PLATO Project 63

Instructional Lessons 64
Research Programs 66
Utilities 66

LIST OF TABLES

		Page
1.	Courses Using PLATO During 1976-77	7
2.	PLATO Project Leaders at the University of Delaware	10
3.	Staff of the Delaware PLATO Project	11
4.	Training Curriculum for Users and Authors	14
5.	1977 ADCIS Pre-Session Agenda	20
6.	Presentations by Delaware Faculty and Staff at the 1977 ADCIS Convention	21
7.	Seven-Year Master Plan for the Growth of the Delaware PLATO Project	23
8.	Comparison of Experimental and Control Group Performance in Music	59
9.	Comparison of Experimental and Control Group Performance in Latin	60

LIST OF FIGURES

Page

1. Quarterly Usage of the Delaware PLATO Project 4
2. At-Terminal Developmental Time by Project (Cumulative 9/75-5/77) 5
3. Task Assignment Chart 13
4. Signing on for Selected Lesson Review: The Name 17
5. Signing on for Selected Lesson Review: The Course 17
6. Signing on for Selected Lesson Review: The Password . . . 17
7. Index of Programs Selected for Lesson Review 17

Sample Displays from PLATO Lessons; used with permission

8. Neuron Structure and Function, by S. H. Boggs 25
9. Plant Responses and Apical Dominance, by Mary Manteuffel and John Noell 25
10. Genetics: Punnett Square, Chi Square, Mendelian Ratios, and Problems, by John Noell, Gary N. May, Alan Haney, and John Silvius 26
11. Unit Design, by Ray Nichols; creating the basic image . . 27
12. Unit Design, by Ray Nichols; creating the composite . . . 27
13. Unit Design, by Ray Nichols; the finished product 28
14. Grey Scale, by Ray Nichols 28
15. Letter Spacing, by Ray Nichols 29
16. Imperfect Competition, by Donald W. Paden, James Wilson, and Michael D. Barr 30
17. Imperfect Competition, by Donald W. Paden, James Wilson, and Michael D. Barr 30
18. Qualitative Organic Analysis, by Stanley Smith 31
19. Acid-Base Titrations, by Stanley Smith 31
20. The Talking Robot: A Simulation of Speech Sound Production, by James H. Wilson and Elaine P. Paden . . 32
21. Organogenetic Feature Drills, by James H. Wilson and Elaine P. Paden 32
22. Interest Inventory from The Self Directed Search, by John L. Holland 34
23. Occupational Search, by Richard Sharf 34
24. Animal Bagger, by Bonnie Anderson Seiler 35
25. Grafit, by Bruce Sherwood 35

LIST OF FIGURES (Continued)

		Page
26.	The Dvorak Simplified Keyboard, by John D. Eisenberg	36
27.	Lesson Debugs, by Marshall Midden	36
28.	Flanders Interaction Analysis, by Owen F. Gaede	37
29.	Flanders Interaction Analysis: student-teacher dialogue, by Owen F. Gaede	37
30.	Transformations, Z-scores and the Normal Curve, by Jerry L. Cohen and staff	38
31.	Read Along with PLATO, by Peter Pelosi	38
32.	Penny Words, by The PLATO Elementary Reading Group, University of Illinois, under NSF contract C-723	39
33.	A Routine for collecting Multidimensional Scaling Data to Study the Distinctive Features of Various Types of Tabular and Graphical Data Displays, by Victor R. Martuza	39
34.	Pronoun Agreement, by Delores Lipscomb	40
35.	Paragraph Editing: Word Usage, by Errol Magidson and Mitsuru Yamada	40
36.	Body Measurement, by Dorothy K. Elias, Frances W. Mayhew, and Frances K. Smith	41
37.	Determining Needed Alterations, by Dorothy K. Elias and Frances K. Smith	41
38.	Substitution Drill Maker, by Dan Williams	42
39.	Beginning Latin, by Richard T. Scanlon	42
40.	Introduction to Spanish Culture, by Armando Armengol and Brian Dutton	43
41.	GUIDO Intervals Program, by Fred T. Hofstetter and William H. Lynch	44
42.	Music Fundamentals, by Peter J. McCarthy	45
43.	Set Theory Program, by James Trueblood	45
44.	Problem Oriented Medical Record, by David Stutz and Jim Romanchek	46
45.	The Pupillary Light Reflex, by A. Marshall, L. C. Helper, and John Silver	46
46.	Projectile Motion in Sports Skills, by Robert M. Reece and Charles Dillman	49
47.	Ring Game: Exercise in Balancing Forces, by Carol Bennett	50
48.	Graphical Kinematics, by E. B. McNeil	50
49.	Multiple Probability Learning, by Jerry Cohen	51
50.	Memory Research, by John McLaughlin	51

Page

51. Interactive Timeline, by Brian Hansen 52
52. Process of Inquiry in Departments Using PLATO 54
53. Student Questionnaire Used in the Delaware PLATO Project . 55
54. Test Format and Scoring for the Music Exam 58

INTRODUCTION

The first report of the Delaware PLATO Project was presented at the January, 1976 meeting of the Association for the Development of Computer-based Instructional Systems (ADCIS). Entitled "Results of the 1975 Delaware PLATO Project," it describes how the university installed its first terminal on March 14, 1975 on an experimental basis in order to determine whether the faculty would show interest in using it to improve instruction and educational research. An introductory PLATO programming course was given for faculty members from various academic areas of the university, and as the need for terminal time increased, a second terminal was procured. By the end of that first year nine departments had made the commitment to develop materials and try out PLATO with students.

Since that time the PLATO Project has progressed to the point at which it is becoming an established part of the university's academic program. There are now twenty-five departments using PLATO, and the number of terminals has gradually increased to thirty-two in order to meet increasing demands for terminal time. More than 1,700 students have taken courses using PLATO, and a comprehensive evaluation of their opinions has been done. The PLATO support staff has been organized into three levels, namely, senior staff, junior staff, and trainee staff. The PLATO training program which began in 1975 with an introductory programming course has evolved into a comprehensive training curriculum including beginning and advanced programming, lesson design, lesson review, and research and development. Using routines developed to save and analyze student responses given in instructional lessons, the faculty has found that PLATO is a valuable tool for research as well as for instruction.

This report is organized into three main divisions: project history and development, departmental applications, and evaluation. Following these is an appendix which contains a catalog of courseware under development at Delaware. Grateful acknowledgement is made to Professor Ray Nichols of the university's art department for producing the photographs used in this report.

CHAPTER I. HISTORY AND DEVELOPMENT OF THE DELAWARE PLATO PROJECT

-Background-

The Delaware PLATO Project originated in the Fall of 1974 during deliberations of the university's computer applications to education committee. The committee planned a series of seminars and demonstrations for the purpose of making available to the Delaware faculty information on how a computer-based educational system may function in a university, and of evaluating what part such a system might play in the future of the university and its supporting community. A major portion of the committee's planning consisted of the review and selection of a computer-based educational system which could support the demonstration. The criteria used in making the selection provide a summary of the reasons why PLATO was chosen for the demonstration. They required that the demonstration system contain:

1) An overall system design which can support many instructional strategies such as gaming, simulations, testing, drill-and-practice, and self-paced programmed instruction.

2) An existing library of demonstration programs encompassing many academic areas.

3) A programming language which is both easy for faculty members to learn, and at the same time powerful enough to support instructional computing.

4) A student record-keeping capability to support educational research in learning behaviors.

5) High-speed interactive graphics for both textual and pictorial displays.

6) A very good overall system reliability.

The first terminal was installed at the university on March 14, 1975. A committee of faculty members selected from seventeen academic areas coordinated demonstrations of PLATO for each of the respective areas, encouraged interested faculty members to enroll in a seven-week seminar on author training, and solicited proposals from each college regarding the implementation of existing courseware and/or the development of new PLATO programs. By the end of May, nine departments had proposed to develop materials and try out PLATO with students.

During the summer of 1975 the proposals were approved, and the university ordered seven additional PLATO terminals to support program development. The first full-time professional PLATO programmer/analyst was hired to teach

PLATO seminars and assist faculty members with difficult programming problems, and eight part-time student programmers were employed to help write programs for individual departments. The project was held back somewhat by the amount of lead time needed to procure the additional PLATO terminals. One terminal was available right away, and was installed in September of 1975. However, the other six took longer to procure and were not installed until February of 1976.

This delay prevented large scale development of PLATO programs during the Fall of 1975, when the two available terminals were used mainly for lesson review, demonstrations, author training, and planning the development of new material. During this period the faculty committee refined its PLATO proposals, and made plans for the first large-scale use of PLATO with Delaware students to begin during the Fall semester of 1976. On February 2, 1976, the committee submitted a proposal requesting the procurement of 24 terminals for student use. On April 28, 1976, this proposal was approved.

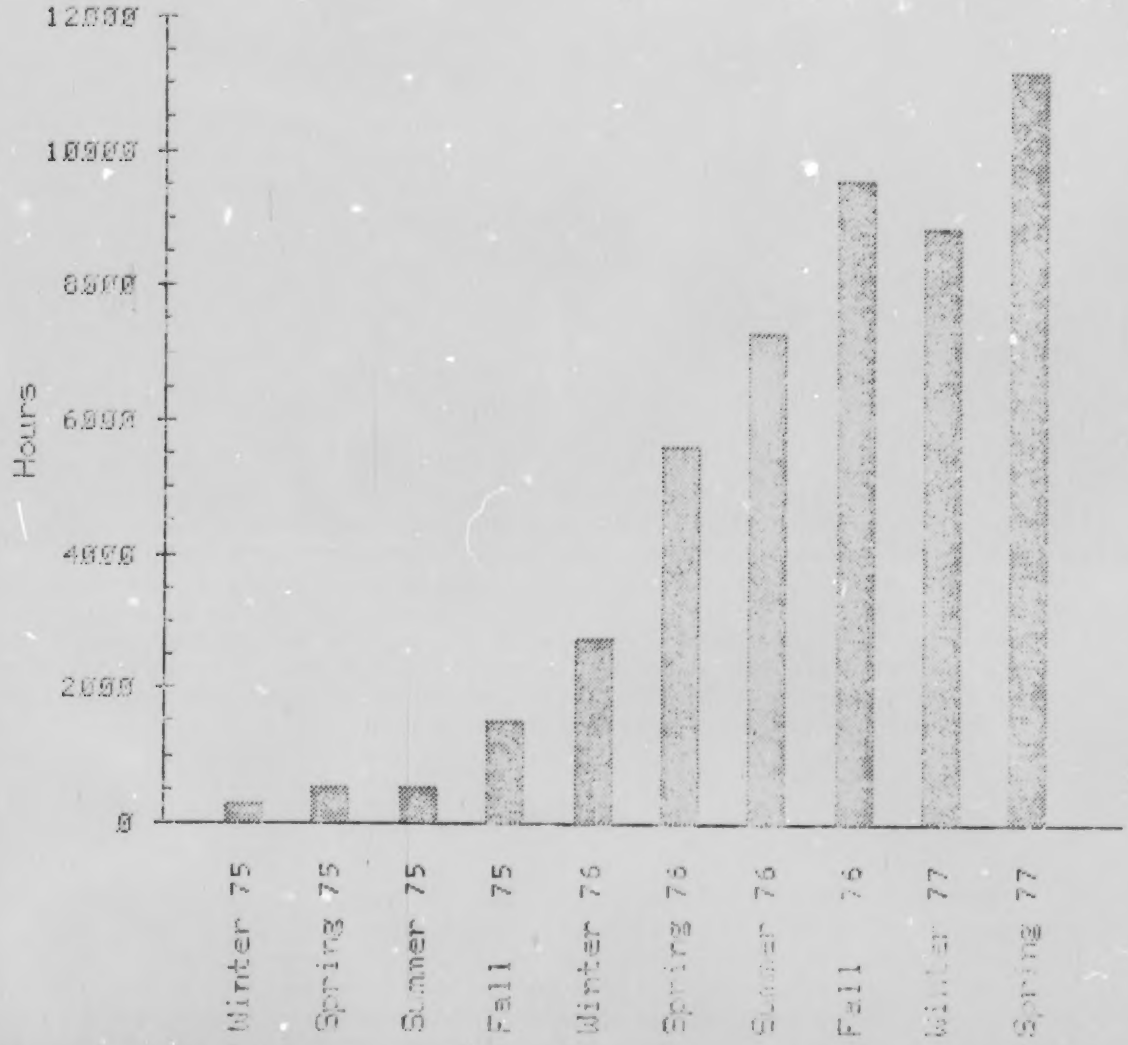
During the Spring and Summer of 1976, the faculty continued to prepare materials for student use. Utilization of the eight authoring terminals was high, averaging about sixty hours per terminal per week. PLATO continued to generate new interest, and by the beginning of the Fall semester there were sixteen departments planning to use the student terminals. However, the project was held back again due to the long lead time needed to order terminals and the care which had to be taken in negotiating a fair services contract for the university. In September the project grew to a total of 12 terminals to support both development of programs and student use of PLATO during the Fall semester of 1976. It was not until March 15, 1977, midway into the Spring semester of 1977, that the project reached the desired level of 24 student terminals and 8 authoring terminals.

-Utilization-

From the beginning of the project there has been a steady rise in the utilization of PLATO at the University of Delaware. Figure 1 shows the project's growth in terms of hours of terminal usage per quarter. The sharpest rise in utilization occurs during the first two quarters of 1976, when serious development of new programs began, and continues through the last two quarters of 1976, when large-scale use by students began. The average utilization on a per-terminal basis has been sixty hours per terminal per week. The highest weekly figure was during October of 1976 when each terminal was used an average of eighty hours per week.

Figure 1

Quarterly Usage of the Delaware PLATO Project



Use of PLATO is broken down into two main categories: "developmental use," when instructors program new materials and plan for the use of existing programs, and "student use," when PLATO is used for instructional purposes. Figure 2 shows the amount of developmental usage accumulated by each department since September, 1975. Some departments have higher accumulations than others partly because they began program development earlier in the project.

Figure 2

At-terminal Developmental Time by Project
(Cumulative 9/75 through 5/77)

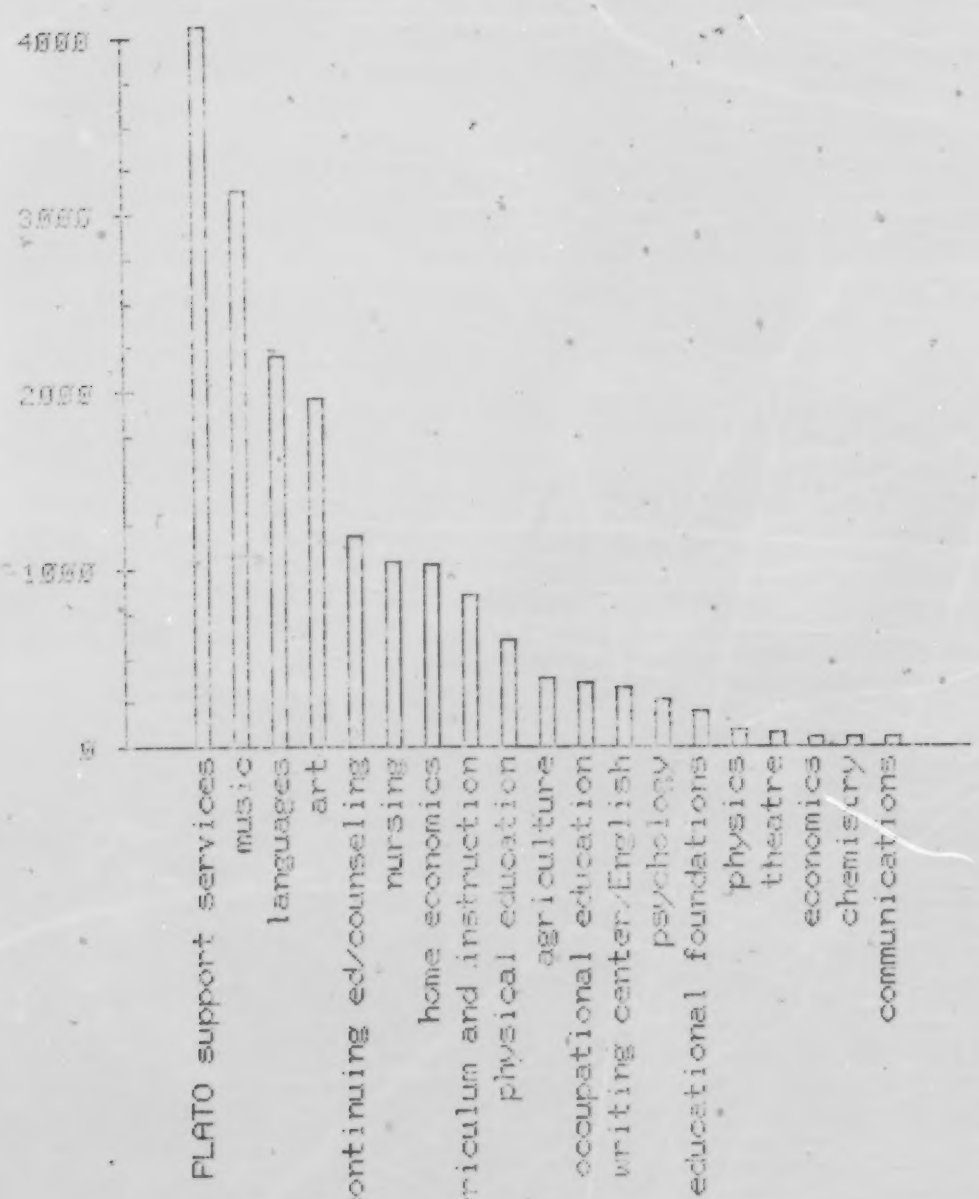


Table 1 contains a list of courses in which PLATO was used during the 1976-77 academic year. Column 1 gives the course symbol and number from the university's course catalog. Column 2 contains a descriptive title for the course. Column 3 gives the number of credit hours. Column 4 shows how many students used PLATO in the course. Column 5 gives the average number of hours each student used PLATO. The last three columns indicate whether the course used PLATO in the first semester, the winter session, or the second semester. 1,706 students in 49 courses used PLATO during 1976-77. They accumulated a total number of 14,673 hours spent at PLATO terminals.

Table 1

Courses Using PLATO During 1976-77

Course Symbol and Number	Descriptive Title	Number of Credit Hours	Number of Students	Average Terminal Hours per Student	Time of Utilization		
					1st Semester	Winter	2nd Semester
APS 101	Animal Science	4	18	10.0	X		
APS 133	Anatomy and Physiology	4	20	2.2	X		
APS 134	Anatomy and Physiology	4	36	9.7			X
APS 341	Genetics of Farm Animals	3	24	4.5	X		
APS 641	Reproductive Physiology of Domestic Animals	3	4	0.8	X		
ART 121	Design I	3	93	6.1	X	X	
ART 200	Lettering	3	68	3.3	X		X
ART 400	Advertising	4	21	0.9			X
C 112	General Chemistry	3	100	4.0	X		
COM 275	Phonetics	3	25	4.0			X
E 011	English Essentials	3	24	5.7			X
E 067	Remedial English	3	17	12.0	X		
EC 101	Introduction to Economics	3	35	3.0	X		X
EDC 324	Evaluation & Correction Procedures in Reading	3	17	2.5		X	
EDC 372	Elementary School Arithmetic	3	1	7.0	X		
EDC 380	Secondary Materials and Approaches	3	6	6.0			X
EDC 630	Teaching Algebra	3	6	2.5	X		
EDC 824	Advanced Analysis of Reading Retardation	3	10	1.0	X		

Table 1 (Continued)

Courses Using PLATO During 1976-77

Course Symbol and Number	Descriptive Title	Number of Credit Hours	Number of Students	Average Terminal Hours per Student	Time of Utilization		
					1st Semester	Winter	2nd Semester
EDF 665	Elementary Statistics	3	10	5.1	X		
EDF 867	Graduate Statistics Review	3	18	2.1			X
EDO 381	Methods of Teaching Secretarial Studies	3	4	5.0	X		
EDO 467	Project CAPE	3	30	1.0	X		
EDO 674	Contemporary Issues in Occupational Education	3	21	1.0			X
EDP 566	Special Problems: Computer-based Ed. - PLATO	1	2	5.0		X	
EDP 567	Computer-Based Ed. - PLATO	3	12	30.0	X		
EDP 653	Occupational and Educational Information	3	28	1.0			X
FHP (Freshman Honors Program)	Introduction to Experimental Psychology	3	34	3.4			X
FR 102	Elementary French II	3	26	5.0			X
FR 111	Intermediate French	3	20	4.0			X
GER 101	Elementary German I	3	4	1.0			X
LAT 101	Elementary Latin I	3	17	20.0	X		
LAT 102	Elementary Latin II	3	6	8.0			X

Table 1 (Continued)

Courses Using PLATO During 1976-77

Course Symbol and Number	Descriptive Title	Number of Credit Hours	Number of Students	Average Terminal Hours per Student	Time of Utilization		
					1st Semester	Winter	2nd Semester
MU 105	Fundamentals of Music	3	40	10.0			X
MU 110	Chorale	1	40	10.0	X		
MU 185	Music Reading - Ear Training I	2	60	28.0	X		X
MU 186	Music Reading - Ear Training II	2	60	28.0	X		X
N 301	Nursing: Adult Physical Health & Illness I	10	20	9.3	X		
N 366	Clinical Experience	3	30	9.3	X		
N 401	Nursing: Maternal & Child Health	12	46	1.0	X		
N 406	Nursing in Adult Physical Health & Illness II	10	27	3.1	X		
N 421	Nursing Care: Adult with Neuropathology	2	5	2.0			X
N 840	Medical-Surgical Nursing I	4	9	9.0		X	
PLS 102	Botany of Economics Plants II	4	35	16.0			X
PLS 867	Seminar: Plant Science	1	8	6.0	X		
PS 207	General Physics	4	20	8.5	X		
PSY 312	Learning and Motivation	3	32	1.5	X	X	X
SP 111	Intermediate Spanish	3	14	2.5	X		X
TC 211	Clothing IA: Basic Processes	3	9	8.0	X		

-Organization-

There are two main components in the organization of the Delaware PLATO Project. The first is its division according to academic departments requesting the use of PLATO services. The second is the approach taken by its staff in order to provide those services. In each department there is a faculty member identified as "PLATO project leader." The project leader serves as an intermediary between the PLATO staff and the rest of the faculty in the department. The project leader coordinates all PLATO activities for the department, including evaluation. All final decisions regarding the content of PLATO lessons are made by the project leader. Most project leaders use a peer review process whereby they obtain help from their colleagues in making these decisions. The energy, enthusiasm and dedication of the faculty has been a very important factor in the implementation of PLATO at the university. Table 2 contains a list of the PLATO project leaders.

Table 2

PLATO Project Leaders at the University of Delaware

Department	Project Leader
Agriculture	Donald Fieldhouse
Art	Raymond Nichols
Chemistry	John Burmeister
Communications	George Borden
Continuing Education	Richard Gearhart
Counseling	Richard Sharf
Curriculum & Instruction	John Brown and John Pikulski
Economics	James O'Neill
Educational Foundations	Victor Martuza
Freshman Honors Program	Donald Harward
Home Economics	Frances Mayhew
Latin	Gerald Culley
Military Science	George Bailey
Music	Fred Hofstetter
Nursing	Mary Anne Early
Occupational Education	James Morrison
Physical Education	David Barlow and James Kent
Physics	Cheng-Ming Fou
Professional Services	John Gaynor
Psychology	John McLaughlin
Statistics & Computer Science	Won Lyang Chung
Theatre	Brian Hansen
Upward Bound	William Morris
Writing Center	Louis Arena

As requests for the use of PLATO have increased, the university has developed a highly trained staff to support the project. At the beginning of the project the staff consisted of three graduate assistants. When the faculty's request for expansion to a level of eight terminals was approved in the summer of 1975, a senior applications programmer/analyst became the first professional staff member of the project, and the number of student assistants was increased to eight. During the summer of 1976, in preparation for large-scale student use of PLATO, a second professional programmer/analyst was hired, and the number of student assistants was increased from eight to twelve. During the Winter of 1976-77, six of the student assistants demonstrated that they had met the qualifications for junior staff positions, and they were promoted to junior PLATO applications programmer/analysts. From its beginning the Delaware PLATO Project has been directed by a university faculty member who continues teaching in addition to other duties. At the time of the writing of this report, a search is underway to hire an assistant director to help in the administration of the project. Table 3 shows the staff of the Delaware PLATO Project. The codes given in column 3 are used to identify each staff member in the project's task assignment chart which is discussed on the next page.

Table 3

Staff of the Delaware PLATO Project

Position	Name	Code
Director	Fred T. Hofstetter	Dir
Assistant Director	-Search Underway-	Asst
Senior Secretary	Gabriele Leipert	Sec
Senior Staff	James H. Wilson	S1
Senior Staff	Bonnie A. Seiler	S2
Junior Staff	Dorothy Elias	J1
Junior Staff	William Lynch	J2
Junior Staff	James Trueblood	J3
Junior Staff	Jessica Weissman	J4
Junior Staff	Charles Wickham	J5
Junior Staff	Dan Williams	J6
Trainee Staff*	Debbie Braendle	T1
Trainee Staff	Michael Larkin	T2
Trainee Staff	Mark Laubach	T3
Trainee Staff	Joseph Maia	T4
Trainee Staff	Stuart Markham	T5
Trainee Staff	Karna Mathre	T6
Trainee Staff	William Resnicow	T7
Trainee Staff	Judy Sandler	T8
Trainee Staff	Richard Thomas	T9
Trainee Staff	Daniel Tripp	T10

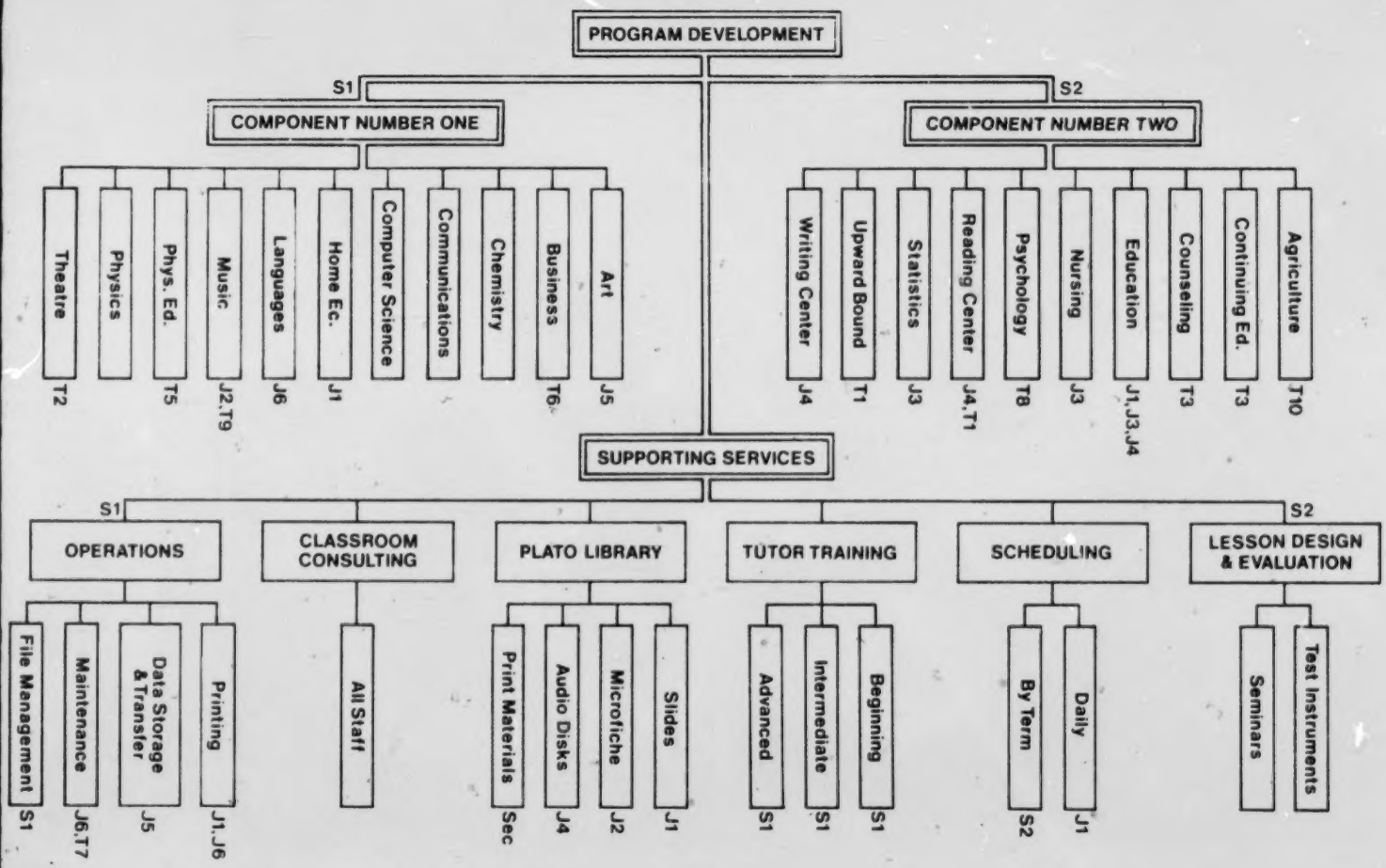
*All trainee staff are miscellaneous wage earners.

The number of tasks needed to support program development, experimentation, student use, and evaluation for the many departments using PLATO requires that each staff member of the PLATO project carry out multiple assignments. Figure 3 contains the task assignment chart of the Delaware PLATO Project. It shows how staff members have assignments at two different levels, namely, program development and supporting services. In program development each staff member is assigned to write programs for one or more departments. In addition, each staff member assumes one or more additional roles under supporting services which include operations, classroom consulting, library cataloging, TUTOR training, scheduling, lesson design and evaluation.

Operational duties include the management of files such as instructional programs, utility routines, and work spaces in the computer memory; maintenance of terminals and peripheral equipment; data storage and transfer from PLATO to the university's computers and vice versa; and printing of graphic displays and data files as requested by the faculty. All staff members share the responsibility of providing consultation to users in the PLATO classroom. The PLATO library consists of four main parts: first, print materials, which include all available publications dealing with PLATO and significant publications by users of other systems; second, audio disks, which store up to 22 minutes of pre-recorded audio materials for use with PLATO's random access audio device; third, microfiche slides, which contain up to 256 slide images which can be rear-projected onto the screen of the PLATO terminals; and fourth, 35mm color slides of PLATO displays, facilities, and related materials, which are used in demonstrations and other presentations.

A comprehensive TUTOR training program is maintained in order that staff members can increase their programming abilities, and so that prospective authors of new PLATO lessons can learn the authoring language. Scheduling the use of PLATO materials takes place on two levels. First, a master schedule is made up for each academic term showing the overall pattern of usage expected for that term. Second, a daily schedule is maintained to accommodate fluctuations from the master plan and to make maximum use of the facilities. Lesson design and evaluation are essential components of the project. Seminars are held regarding techniques of educational design and evaluation, and a catalog of test instruments is kept with examples of their applications.

FIGURE 3*
TASK ASSIGNMENT CHART



*Abbreviations used in this chart are given in Table 3 (page 11).

-Instructor and Author Training-

A series of weekly seminars is offered four times a year in order to give members of the university and its surrounding community an opportunity to learn about various aspects of the PLATO system. There is a short orientation seminar for those who want a brief overview, a sequence of two courses in TUTOR programming, a course in lesson design, a lesson review seminar, and a research and development seminar. These seminars are offered free of charge for no credit. In addition, a computer-based education seminar is taught through the College of Education for those wishing to earn graduate credit. The course descriptions are given in Table 4.

Table 4

Training Curriculum for Users and Authors

1. General Orientation to the PLATO System. Three lecture-discussions outlining general purposes and uses of the PLATO system. Includes inspection of existing instructional programs, use of communications features for monitoring student progress, and guidelines for considering the use of PLATO in your own instruction and educational research.

2. Beginning TUTOR Programming. Ten lecture-discussions emphasizing the fundamentals of TUTOR, PLATO's programming language. Intended for those who have little or no background in computers. Allow two to four hours per week for practice at a terminal.

3. Intermediate TUTOR Programming. Ten one-hour discussions emphasizing advanced topics in PLATO programming. Prior knowledge of TUTOR is a prerequisite. Allow two to four hours per week for practice at a terminal.

4. PLATO Lesson Design. Ten workshops for those who will be making design decisions and/or implementing them for PLATO lessons. Emphasis will be on examining existing lessons for display techniques, answer handling, mode of instruction, organization, and style. Participants will design small modules of instruction and practice making decisions at different stages of lesson development. Faculty and programmers may wish to work together.

5. PLATO Research and Development. An on-going, informal seminar intended to provide a forum for the exchange of ideas among developers of PLATO programs at the University of Delaware. Topics include lesson design, programming, implementation, evaluation, and experimentation.

6. PLATO Lesson Review. An informal weekly review of lessons currently being developed at Delaware. Emphasis is on improving our instructional materials through on-going analysis and discussion with the lesson authors.

Table 4 (Continued)

Training Curriculum for Users and Authors

7. Special Topics Sessions. Any department or other group that is interested in a particular topic, such as using PLATO for research or examining lesson material in a given subject area, may wish to arrange one or several special sessions at the convenience of participants.

8. EDP 567 Seminar: Computer Based Education - PLATO (3)
General introduction to the use of computers in instruction and to the development of computer-based lessons on the PLATO system. Includes discussions of hardware configurations, modes of instruction, the processes of implementation and validation, and reviews of many existing projects throughout the country. Considers the design of lessons and the structure of the TUTOR language.

Since the beginning of the project a growing number of teachers from Delaware's public schools have become interested in using PLATO in the classroom. In response to their requests for an opportunity to learn more about computer-based education, a Summer Institute in Computer-based Education was held during July of 1976. Jointly funded by the University and the Delaware School Auxiliary Association, the institute offered instruction on PLATO and on Project DELTA, a mini-computer based system with terminals in many of Delaware's high schools. In addition, all participants attended a seminar to discuss issues raised in the new book by Hunter et al., Learning Alternatives in U.S. Education: Where Student and Computer Meet (Englewood Cliffs: Educational Technology Publications, 1975).

Special presentations were made by participating faculty from several disciplines. These included art, presented by Ray Nichols of the University's art department; physics, by Richard Herr of physics; mathematics, by Bonnie Seiler of the PLATO staff; computer-assisted testing, by Robert Uffelman of education; music, by Fred Hofstetter of music; computer-managed instruction and vocational-technical training by John Matthews and Ed Boas of education; administrative computing, by John Falcone of the computing center; MENTOR, by Hank Hufnagel of the computing center; WANG minicomputers, by Derryl Pelley of the mathematics department at Glasgow High School; chemistry, by Henry Blount of the chemistry department; DELTA by Teresa Green of the university's DELTA Project; and PLATO, by Jim Wilson of the PLATO staff. Many of the participants in the institute have gone on to develop, test, and implement computer programs in their respective schools. Contact with them is maintained through a periodic newsletter.

-Lesson Review-

The first step in getting started with PLATO usually consists of the review of lesson materials which have already been developed. The courseware library contains more than 6,000 hours of instruction in seventy-one subjects. A comprehensive guide to these materials is Elisabeth R. Lyman's PLATO Curricular Materials (University of Illinois at Urbana-Champaign: Computer-Based Education Research Laboratory, 1977), which lists the programs according to subject areas. Copies of this guide are kept in the PLATO library.

The review of PLATO lessons can provide the potential user with some ideas for the use of existing programs or the development of new programs. Reviewing PLATO lessons written for subjects outside the teaching areas of the reviewer can often lead to ideas for applications in the reviewer's own subject. For example, review of the reading materials demonstrates the use of the random access audio disk; art lessons show the power of PLATO's graphics; and music lessons show how the use of the touch panel can lead to easy, natural man-machine communications.

In order to promote and facilitate the review of lessons in the Delaware PLATO Project, a special sign-on has been created which gives the prospective user immediate and easy access to the main areas of program development. Instructions for using this sign-on are as follows. First, when PLATO asks for your name, type "demo" as shown in figure 4 and press NEXT; second, when PLATO asks for your course, type "udtutor" as shown in figure 5 and while holding down the shift key press STOP; third, when PLATO asks for your password, type "welcome" as shown in figure 6 and press NEXT. PLATO will then display an index of materials selected for lesson review. The index is shown in figure 7. The reviewer can run programs by typing the appropriate letters from the index.

For persons who have never used a PLATO terminal before, a special lesson has been written by Jessica Weissman of the Delaware PLATO staff. Entitled "How to Use PLATO," it teaches the new user all about the operation of the terminal. Topics include the keyboard, use of special keys, (e.g., NEXT, BACK, HELP, STOP, TERM), how to respond to questions, formats for scientific and numerical answers, use of peripherals (e.g., touch panel, music box, slide selector), and use of special features like the on-line calculator. The lesson has been designed that instructors can have their students learn about the terminal on their first visit to a PLATO classroom. Its modular format allows the instructor to specify which features should be included to suit the needs of a particular group of students.

Figure 4. Signing on for Selected Lesson Review: The Name.

Type the name of your PLATO course, then hold down
the SHIFT key and press the STOP key.
When you are ready to leave, you should press
these same keys (SHIFT-STOP) to "sign off."
> udtutor

Figure 5. Signing on for Selected Lesson Review: The Course.

Figure 6. Signing on for Selected Lesson Review: The Password. PLATO always shows a series of X's when the password is typed in order to prevent other people from seeing the password.

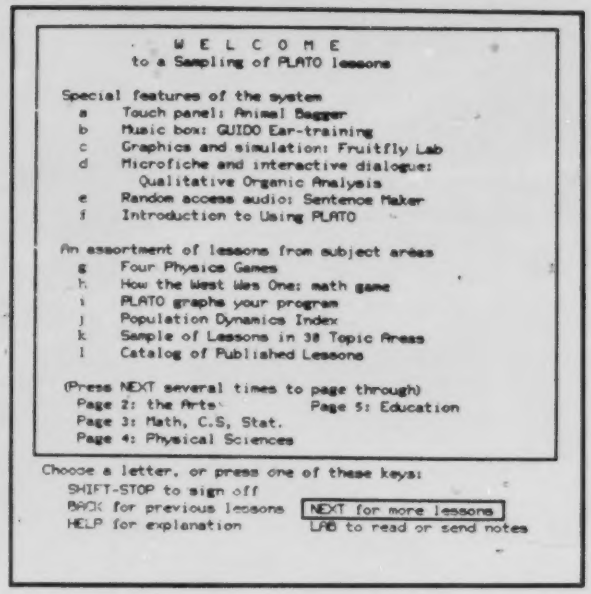

W E L C O M E
to a Sampling of PLATO lessons
Special features of the system
a Touch panel: Animal Bagger
b Music box: GUIDO Ear-training
c Graphics and simulation: Fruitfly Lab
d Microfiche and interactive dialogue:
Qualitative Organic Analysis
e Random access audio: Sentence Maker
f Introduction to Using PLATO
An assortment of lessons from subject areas
g Four Physics Games
h How the West Was One: math game
i PLATO graphs your program
j Population Dynamics Index
k Sample of Lessons in 38 Topic Areas
l Catalog of Published Lessons
(Press NEXT several times to page through)
Page 2: the Arts
Page 3: Math, C.S, Stat.
Page 4: Physical Sciences
Page 5: Education
Choose a letter, or press one of these keys:
SHIFT-STOP to sign off
BACK for previous lessons
NEXT for more lessons
HELP for explanation
LAB to read or send notes

Figure 7 (a). Index of Programs Selected for Lesson Review.

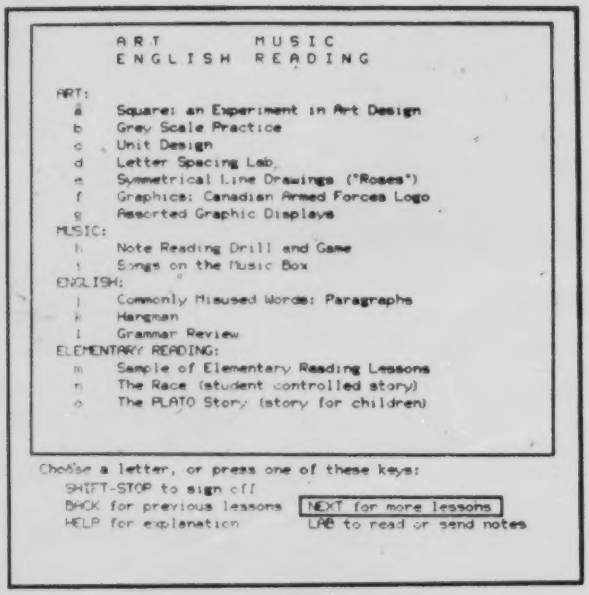

ART MUSIC
ENGLISH READING
ART:
a Square: an Experiment in Art Design
b Grey Scale Practice
c Unit Design
d Letter Spacing Lab
e Symmetrical Line Drawings ("Roses")
f Graphics: Canadian Armed Forces Logo
g Assorted Graphic Displays
MUSIC:
h Note Reading Drill and Game
i Songs on the Music Box
ENGLISH:
j Commonly Misused Words: Paragraphs
k Hangman
l Grammar Review
ELEMENTARY READING:
m Sample of Elementary Reading Lessons
n The Race (student controlled story)
o The PLATO Story (story for children)
Choose a letter, or press one of these keys:
SHIFT-STOP to sign off
BACK for previous lessons
NEXT for more lessons
HELP for explanation
LAB to read or send notes

Figure 7 (b). Index of Programs Selected for Lesson Review.

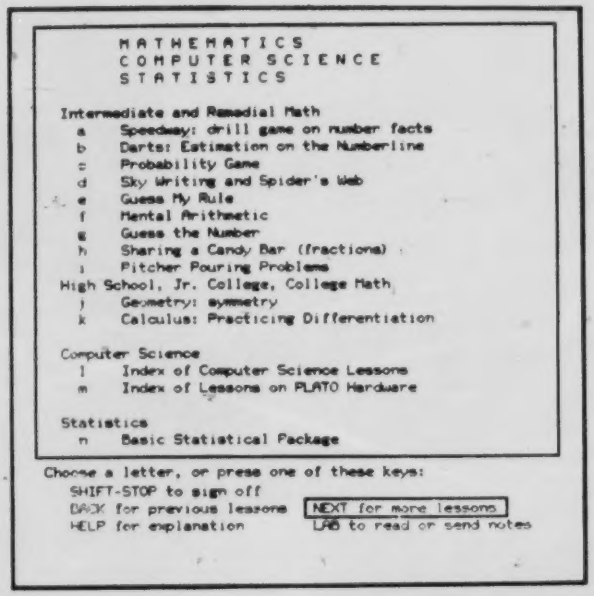

MATHEMATICS
COMPUTER SCIENCE
STATISTICS
Intermediate and Remedial Math
a Speedway: drill game on number facts
b Darts: Estimation on the Numberline
c Probability Game
d Sky Writing and Spider's Web
e Guess My Rule
f Mental Arithmetic
g Guess the Number
h Sharing a Candy Bar (fractions)
i Pitcher Pouring Problems
High School, Jr. College, College Math
j Geometry: symmetry
k Calculus: Practicing Differentiation
Computer Science
l Index of Computer Science Lessons
m Index of Lessons on PLATO Hardware
Statistics
n Basic Statistical Package
Choose a letter, or press one of these keys:
SHIFT-STOP to sign off
BACK for previous lessons
NEXT for more lessons
HELP for explanation
LAB to read or send notes

Figure 7 (c). Index of Programs Selected for Lesson Review.

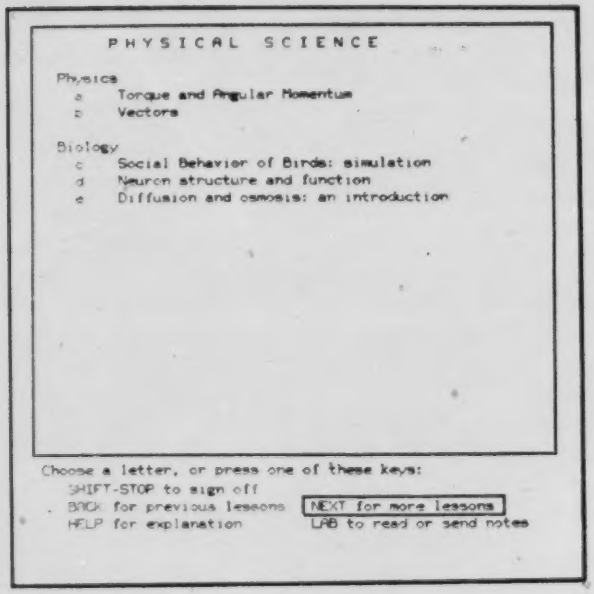

PHYSICAL SCIENCE
Physics
a Torque and Angular Momentum
b Vectors
Biology
c Social Behavior of Birds: simulation
d Neuron structure and function
e Diffusion and osmosis: an introduction
Choose a letter, or press one of these keys:
SHIFT-STOP to sign off
BACK for previous lessons
NEXT for more lessons
HELP for explanation
LAB to read or send notes

Figure 7 (d). Index of Programs Selected for Lesson Review.

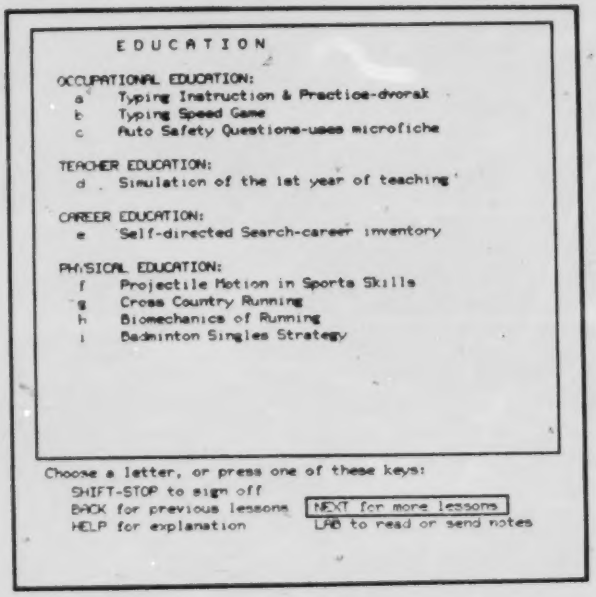

EDUCATION
OCCUPATIONAL EDUCATION:
a Typing Instruction & Practice-dvorak
b Typing Speed Game
c Auto Safety Questions-uses microfiche
TEACHER EDUCATION:
d Simulation of the 1st year of teaching
CAREER EDUCATION:
e Self-directed Search-career inventory
PHYSICAL EDUCATION:
f Projectile Motion in Sports Skills
g Cross Country Running
h Biomechanics of Running
i Badminton Singles Strategy
Choose a letter, or press one of these keys:
SHIFT-STOP to sign off
BACK for previous lessons
NEXT for more lessons
HELP for explanation
LAB to read or send notes

Figure 7 (e). Index of Programs Selected for Lesson Review.

-Participation in ADCIS-

The Delaware PLATO Project is an active participant in the Association for the Development of Computer-based Instructional Systems (ADCIS). ADCIS is the principal national forum for the scholarly exchange of ideas regarding computer-based education, and the project regularly delivers progress reports at the association's annual meetings. Papers have also been presented at ADCIS special interest group meetings for health sciences, implementation, PLATO, elementary-secondary schools, and music. The music interest group was founded by our university's music department by means of the PLATO Project. The Delaware PLATO Project is also fostering the development of special interest groups for art, reading, and home economics.

A big event in the history of the Delaware PLATO Project was hosting this year's ADCIS National Convention at the Hotel DuPont, February 20-24, 1977. Jointly funded by the Delaware School Auxiliary Association, the Wemyss Foundation, ADCIS, and the University of Delaware, the convention attracted the largest attendance in its ten-year history. The participation of 32 vendors made the exhibit area a most comprehensive showing of computer-based educational technology. A special feature was the pre-session held for teachers on Monday, February 21, in cooperation with the State Department of Public Instruction. Entitled "Introduction to Educational Computing," the pre-session was attended by more than 300 Delaware teachers. Table 6 gives the agenda for the pre-session, which was worked out by Dr. Bill Geppert, state supervisor of mathematics and chairman of the state's computing committee.

Table 5

1977 ADCIS Pre-Session Agenda

8:00 - 8:30	Registration - Coffee, Tea, and Doughnuts. Note: In order to guarantee that you will get a seat, send in the pre-session registration form.
8:30 - 9:30	General Session on Computers in Education Keynote Speaker: David H. Ahl, Publisher, *Creative Computing*. A Multimedia Presentation: Computer Power to the People; the Myth and the Reality.
10:00 - 11:15	Concurrent Sessions
	Session I: Major Trends in Educational Computing, Dr. John Hirschbuhl, University of Akron
	Session II: Major Trends in Administrative Computing, Dr. Donald Thomas, Director, Educational Data Systems
	Session III: Introduction to Minis, Micros, and Interfacing: A Hardware Tutorial, Emile Attala, California Polytechnic State University and Robert S. Tannenbaum, Hunter College
	Session IV: Computing Applications in Business Education, Sarah Bell, DPI and James Morrison, University of Delaware
11:15 - 11:30	BREAK
Lunch	Is available in the Exhibit area from 11:30 until 3:00
11:30 - 12:45	Concurrent Computer-Based Education Workshops I
	DELTA: Business Education Computer Curriculum Corporation: Basic Skills with Applications in Special Education IBM: Administrative Applications Science and Computer Applications: Dale Reynard, Brandywine High School Mathematics, John Brown, University of Delaware Social Studies, Mike Epler, Christiana High School
1:00 - 3:45	Continuation of Minis, Micros, and Interfacing Tutorial
1:00 - 2:15	Concurrent Computer-Based Education Workshops II
	PLATO: Arts and Humanities WANG: Mathematics and Science UDCC: Administrative Systems Special Education: Bureau of the Handicapped IBM: A New Dimension in Instructional Computing
2:30 - 3:45	Concurrent Computer-Based Education Workshops III
	PLATO: Science and Mathematics DELTA: Career Guidance ISI: Delaware CAI Project for Exceptional Children Hewlett-Packard: The Instructional Management System and the Instructional Dialogue System DICE, Capital, Wilmington, and UDCC Administrative Computing Roundtable
4:00 - 5:15	Summary of Above Activities; Presentation "Computer Education in Delaware Schools: Where Are We? Where Are We Going?" by Bill Geppert, Department of Public Instruction

During the main portion of the convention, several presentations were made by members of the PLATO staff and of the faculty. These are published in the 1977 ADCIS Proceedings, and are available upon request in the PLATO office. The titles of the presentations are listed in Table 7.

Table 6

Presentations by Delaware Faculty and Staff at the 1977 ADCIS Convention

Name	Title of Presentation
John Brown	"Mathematics Applications of Computer Technology"
John Eisenberg	"Overview of the PLATO Modern Hebrew Project"
Nevin Frantz	"A Computer Managed Instructional System for Vocational Technical Education"
Fred T. Hofstetter	"Interactive Simulation/Games as an Aid to Learning Music"
Hank Hufnagel	"MENTOR - A PLATO-like system of CAI"
Rosemary Killam	"Data Retention and Analysis: Experience and Recommendations"
James Morrison	"Computing Applications in Business Education"
Raymond Nichols and James H. Wilson	"The Computer Display as a Medium in the Teaching of Aesthetics in Visual Design"
Bonnie A. Seiler	"Computer Assistance in the Social Processes of Learning"
Richard Sharf	"A Computer-based Career Guidance System"

-Projections for Future Growth-

At its present level of thirty-two terminals, the Delaware PLATO Project will be able to support the development and testing of materials by the departments using PLATO for about six more months. It has been projected that student and faculty use will saturate the system during the Fall semester of 1977, and that if growth within the departments is to continue, additional terminals will be needed for the Spring semester of 1978. During the 1977-78 academic year new programs will begin in sociology, military science, freshman honors, and upward bound. The departments using PLATO have put together a seven-year master plan for the growth of the project. Given in Table 8, its realization is contingent upon continued success of the project and the availability of funds. The Delaware PLATO Project has reached the point at which it becomes more cost effective to purchase its own computer than to lease time and pay telephone charges to the PLATO machines in Minnesota and Illinois.

Space is a very important consideration in the future of the Delaware PLATO Project. At the present time there are four campus sites at which terminals have been installed. The first is room 210 of the Amy E. DuPont Music Building, which houses five terminals; the second is the Access Center in Clayton Hall which has one terminal; the third is the Department of Educational Foundations, where one terminal is used for research purposes; and the fourth is room 009 in Willard Hall Education Building, where a large terminal classroom holds 25 terminals. Future plans call for additional clusters of from 8 to 32 terminals to be installed at the following locations: the basement of Smith Hall, the languages laboratory, the reading center, the College of Nursing, the writing center, the home economics building, the new wing of the College of Agriculture, and the proposed new wing of the library. The PLATO staff will occupy offices at 46 East Delaware Avenue beginning in the Fall of 1977. This long-range planning will insure that space is available when the project is able to expand.

Table 7

Seven-Year Master Plan for the Growth of the PLATO Project

College, Division or Department	Number of Terminals in Calendar Year Increments							Total
	1975	1976	1977	1978	1979	1980	1981	
Agriculture	1.0		2.0		2.0	1.0	2.0	8.0
Art	1.0	1.0	0.5	1.0		0.5	2.0	6.0
Business & Economics			1.0			1.0	2.0	4.0
Chemistry			1.0	1.0		1.0	1.0	4.0
Communications				1.0	1.0			2.0
Continuing Education		1.0	1.0		2.0	2.0	2.0	8.0
Counseling		0.5	0.5			1.0		2.0
Education	1.0	1.0	3.0	1.0	2.0	2.0	2.0	12.0
English		1.0	1.5	0.5	1.0		2.0	6.0
Home Economics	1.0	0.5	0.5		1.0	0.5	0.5	4.0
Honors Program				4.0		2.0	2.0	8.0
Languages		1.0	1.0	2.0	1.0	1.0	1.0	8.0
Military Science				1.0	1.0		2.0	4.0
Music	1.5	1.0	1.0	1.5	1.0	1.0	1.0	8.0
Nursing	1.0	1.0	1.0		2.0	1.0	2.0	8.0
Physical Education	0.5		0.5		1.0	2.0	1.0	5.0
Physics	0.5		0.5			1.0		2.0
Psychology			0.5			1.0	0.5	2.0
Statistics & Computer Science				1.0		1.0		2.0
Theatre	0.5		0.5		1.0	2.0	1.0	5.0
Upward Bound				2.0		2.0		4.0
Total	8	8	16	16	16	24	24	112

CHAPTER II. APPLICATIONS

This chapter contains a summary of activities in the departments using PLATO at the University of Delaware. Sample lessons have been described with accompanying photographs in order to give the reader a general idea of the kinds of applications being pursued in the project. Study of these descriptions gives not only an overview of the wide range of activities which are being supported in the PLATO system, but it also provides a source of ideas from which new applications can arise.

-Agriculture-

Faculty members from the departments of Animal Science and Plant Science are using PLATO to provide students with simulated laboratory experiments and field experience which would be very costly to provide by other means. Most of the programs were originally developed by the College of Veterinary Medicine and by the Community College Biology Group at the University of Illinois. The successful implementation of these programs at the University of Delaware shows how through "courseware sharing" one institution can take advantage of PLATO programs written elsewhere.

In animal science, beginning students are using PLATO to study veterinary terminology, principles of digestion, muscular movement, mechanics of breathing, neuron structures and functions, spinal reflex loops, eye anatomy, and elementary psychophysiology of audition. Advanced undergraduates study mitotic cell division, probability and heredity, drosophilia genetics, natural selection, mitosis, gene mapping in diploid organisms, blood typing, population dynamics, pedigrees, karyotyping, and DNA, RNA, and protein synthesis. Graduate students concentrate on meiosis and the anatomy and physiology of reproduction.

In plant science, undergraduates run PLATO programs in cellular structure and function, water relations, diffusion, osmosis, genetics, and the spectrophotometer. Graduate students study plant pathology, enzyme experiments, respiration, biogeochemical cycles, enzyme hormone interactions, photosynthesis, seed germination, apical dominance, flowering and photoperiod, fruiting and leaf senescence, gas chromatography, and gene mapping in diploid organisms.

The kind of experience which agriculture students obtain from PLATO is illustrated in the following three examples. Figure 8 shows a sample display from the neuron structure and function program. PLATO simulates neurons with various internal structures. The student stimulates the neurons by pressing keys at the terminal, and observes the effects of the stimulations as read by a recording voltmeter. The student can experiment with different rates and patterns of stimulation. PLATO keeps track of what the student does and provides the student with reports in the form of response graphs.

Figure 9 shows the result of an apical dominance experiment. PLATO has given the student a plant with terminal and lateral buds intact. The student removes the apex, and is given a choice of replacing it with lanolin paste only or with lanolin paste plus one of five hormones. The student can experiment with choosing different hormones and observing their effects on the plant. In this case the student chose ethylene, and the plant branched.

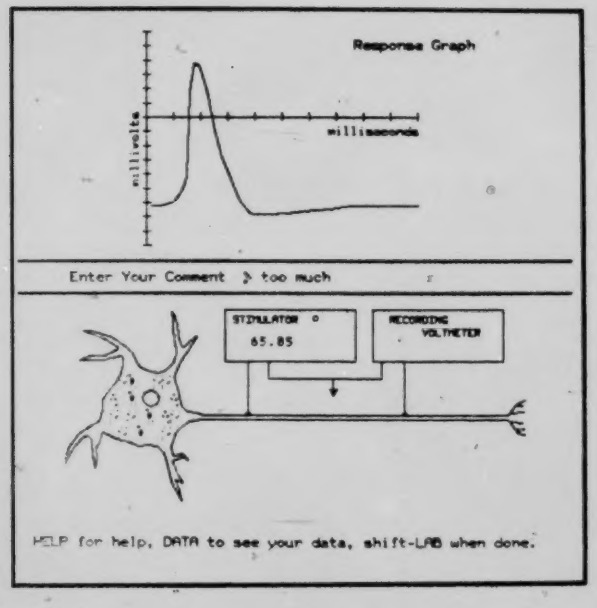


Figure 8. Neuron Structure and Function, by S. H. Boggs. Copyright © 1976 by the Board of Trustees of the University of Illinois.

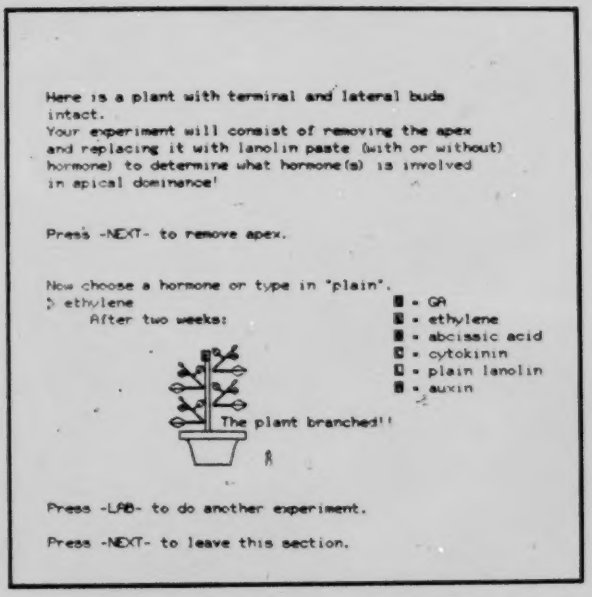

Here is a plant with terminal and lateral buds intact.
Your experiment will consist of removing the apex and replacing it with lanolin paste (with or without) hormone) to determine what hormone(s) is involved in apical dominance!
Press -NEXT- to remove apex.
Now choose a hormone or type in "plain".
) ethylene
After two weeks:
A - GA
B - ethylene
C - abcissic acid
D - cytokinin
E - plain lanolin
F - auxin
The plant branched!!
Press -LAB- to do another experiment.
Press -NEXT- to leave this section.

Figure 9. Plant Responses and Apical Dominance, by Mary Manteuffel and John Noell. Copyright © 1975 by the Board of Trustees of the University of Illinois.

Figure 10 shows how PLATO teaches the student how to run his own experiments. The student begins with the hypothesis that when two corn plants are crossed, the resulting generation will contain green plants and white plants in a ratio of 3:1. PLATO allows the student to cross two plants and observe the results, which in this case produced 100 green plants and 25 white plants. PLATO guides the student through a chi-square test of the hypothesis. When the student successfully completes the experiment, PLATO lets him go back and practice it again as often as he likes with an entirely new set of data each time.

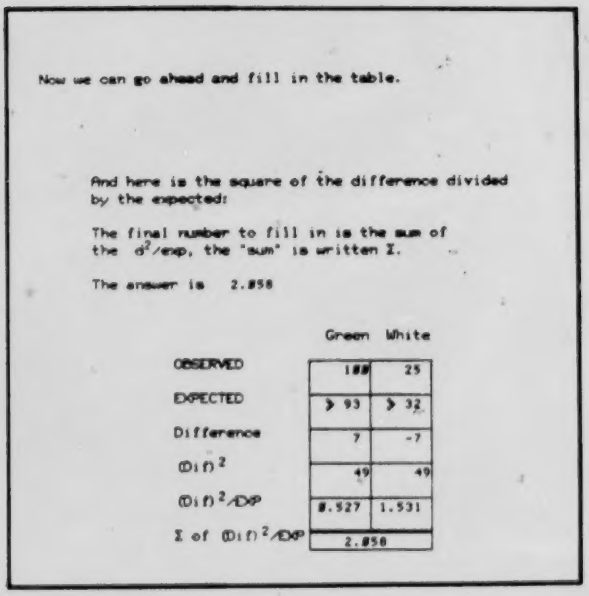

Now we can go ahead and fill in the table.
And here is the square of the difference divided by the expected:
The final number to fill in is the sum of the d²/exp, the "sum" is written Σ.
The answer is 2.858
Green White
OBSERVED 100 25
EXPECTED > 93 > 32
Difference 7 -7
(Dif)²
(Dif)²/EXP 0.527 1.531
Σ of (Dif)²/EXP 2.058

Figure 10. Genetics: Punnett Square, Chi-Square, Mendelian Ratios and Problems, by John Noell, Gary N. May, Alan Harvey, and John Silvius. Copyright © 1976 by the Board of Trustees of the University of Illinois.

-Art-

The art department is developing its own package of PLATO programs for the purpose of improving instruction in basic design and graphic design, including courses in typography, basic illustration, advertising design, and portfolio preparation. Using the highly sophisticated graphics features of PLATO, students are interactively able to create and alter designs on the terminal screen. Work which used to take fifteen hours to complete on paper can be done in three hours on PLATO, thereby giving students the opportunity to work many more problems than they could before. They are also developing a better aesthetic judgment, because PLATO makes it so easy for them to alter their designs. If they don't like part of a design, PLATO lets them change that part while retaining the remainder of the design. Thus students are encouraged to make what they like rather than like what they make.

The main applications of PLATO in art can best be explained by looking at how students use three programs, namely, "unit design," "grey scale practice in tonal recognition," and "optical letter spacing." In the "unit design" program, the student enters a shape into the computer by either turning on or turning off dots on a 96 x 96 dot matrix. Figure 11 shows how the student creates the image by selecting options like "move," "delete point," "store," and "draw line." Next, the student uses the basic shape to form a composite image by performing graphic transformations of the basic shape. Figure 12 shows how the student creates the composite image by rotating, mirroring, and inverting the positive/negative relationships of each element.

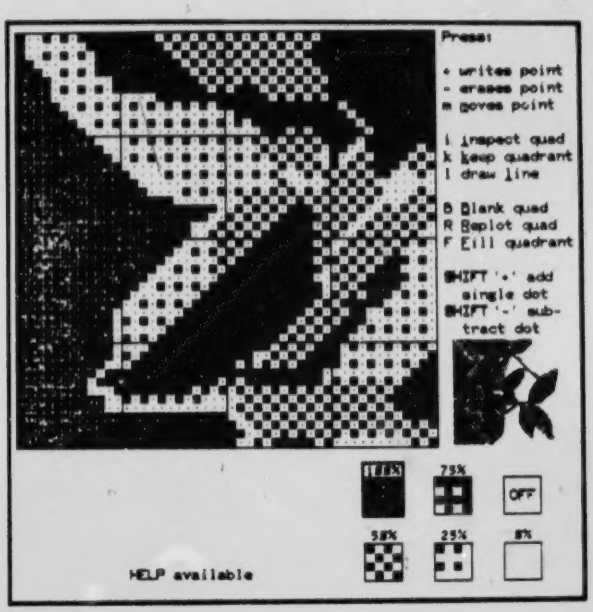


Figure 11. Unit Design by Ray Nichols; creating the basic image. Copyright © 1977 by the University of Delaware PLATO Project.

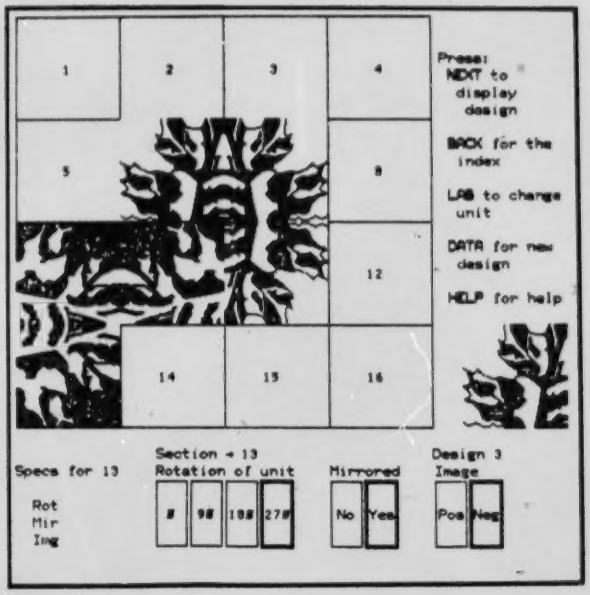


Figure 12. Unit Design by Ray Nichols; creating the composite. Copyright © 1977 by the University of Delaware PLATO Project.

Through successive tries at designing basic shapes and performing graphic transformations, the student learns how to create clever and intricate designs such as the one shown in figure 13.

The grey scale program gives art students practice in recognizing the tonal values of the many shades of grey. PLATO presents the student with a grid of 20 x 30 squares. The student can then see the shade of grey for each square by telling PLATO the percentage of grey which should be in the square. Some students have become so adept at recognizing values of grey on PLATO that they can use the grey scale program to create facial images, such as the one shown in figure 14.

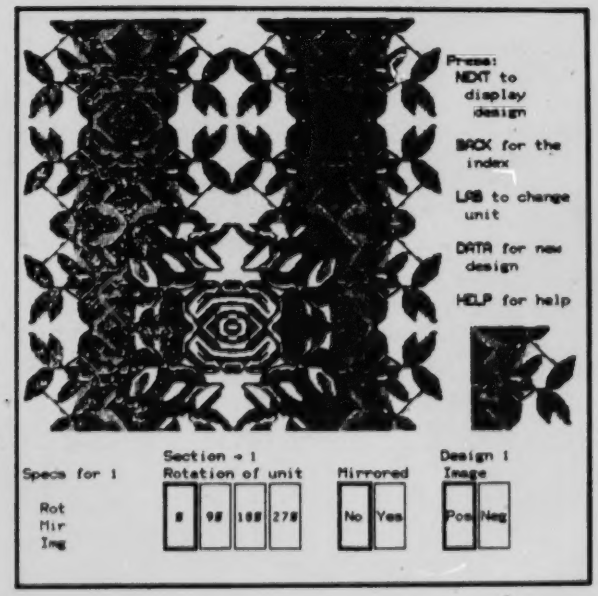


Figure 13. Unit Design by Ray Nichols; the finished product. Copyright © 1977 by the University of Delaware PLATO Project.

Figure 14. Grey Scale, by Ray Nichols Copyright © 1977 by the University of Delaware PLATO Project.

Since typography plays such an important role in advertising, it is extremely important for the art student to be able to space letters so that the printed word is both aesthetically pleasing and readable. The letter spacing program gives the students interactive practice in spacing letters without requiring them to go through the time-consuming process of drawing and inking a word every time they want to change the placement of a letter. Using PLATO, students can do many more assignments than were possible before, and the instructor is able to offer greater help to the students because he gets to see much more of their work. Students can work with words containing up to 9 letters from each of five typefaces: Helvetica, Baskerville, Garamond, Century Expanded, and Bodoni. Figure 15 shows a sample display from the letter spacing program. In this display the student is just about to move the "E" further over to the left.

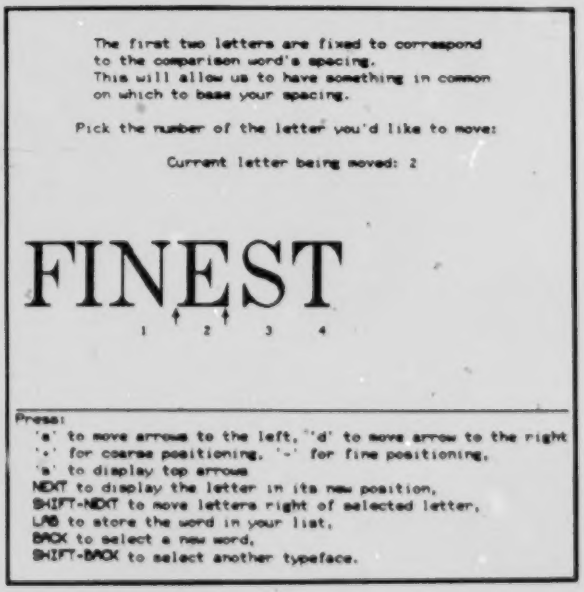

The first two letters are fixed to correspond
to the comparison word's spacing.
This will allow us to have something in common
on which to base your spacing.
Pick the number of the letter you'd like to move:
Current letter being moved: 2
FINEST
1 2 3 4
Press:
'a' to move arrows to the left, 'd' to move arrow to the right
'+' for coarse positioning, '-' for fine positioning,
'a' to display top arrows
NEXT to display the letter in its new position,
SHIFT-NEXT to move letters right of selected letter,
LAB to store the word in your list,
BACK to select a new word,
SHIFT-BACK to select another typeface.

Figure 15. Letter Spacing by Ray Nichols
Copyright © 1977 by the University of Delaware PLATO Project.

Students in macroeconomics are using PLATO to learn the principles and the practice of economic modeling by means of computerized simulations. Students can change economic variables such as income, employment, and price level, and they can observe the effects of these changes in graphs drawn on the display screen. The students can repeat individual lessons as often as they like, and they can move on to more difficult exercises whenever they are ready. The economics package includes quizzes at the end of each lesson to insure that the students have mastered the concepts presented in the simulations. It also gives periodic hourly examinations throughout the semester.

Reading about how autonomous consumption, induced consumption, autonomous investment, induced investment, government spending and the tax rate affect the economy can be very confusing for the beginning student. PLATO presents these concepts in an individualized, self-paced format, making sure that the student understands them before moving on to more difficult material. Figure 16 shows how PLATO uses graphs to teach the ways in which individual firms can influence prices. Firms operating under monopoly, oligopoly, and monopolistic competition are presented. PLATO asks questions which both insure that the student is reading the graphs correctly and also understanding the basic concepts associated with each graph. Figure 17 shows how a display can be dynamically created while the student is working through a lesson. To make sure that the student understands the interaction of the cost curves, PLATO asks the student questions as the curves are drawn. When the student answers correctly, more of the curves are drawn.

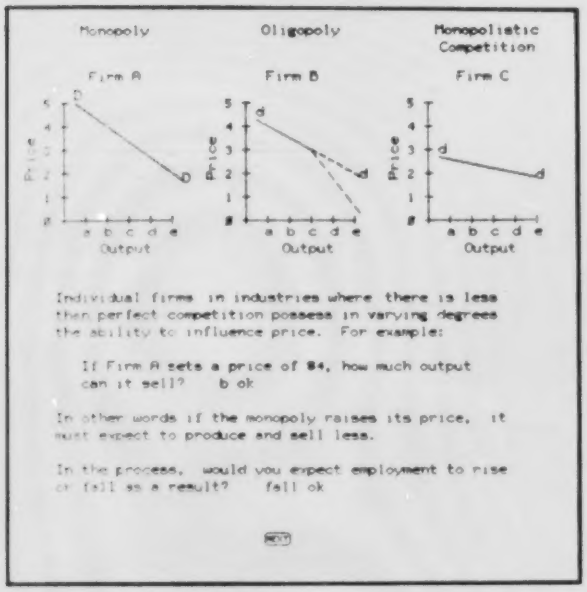

Monopoly
Oligopoly
Monopolistic Competition
Firm A
Firm B
Firm C
Price
Output
Individual firms in industries where there is less than perfect competition possess in varying degrees the ability to influence price. For example:
If Firm A sets a price of $4, how much output can it sell? b ok
In other words if the monopoly raises its price, it must expect to produce and sell less.
In the process, would you expect employment to rise or fall as a result? fall ok
NEXT

Figure 16. Imperfect Competition, by Donald W. Paden, James Wilson, and Michael D. Barr. Copyright © 1975 by the Board of Trustees of the University of Illinois.

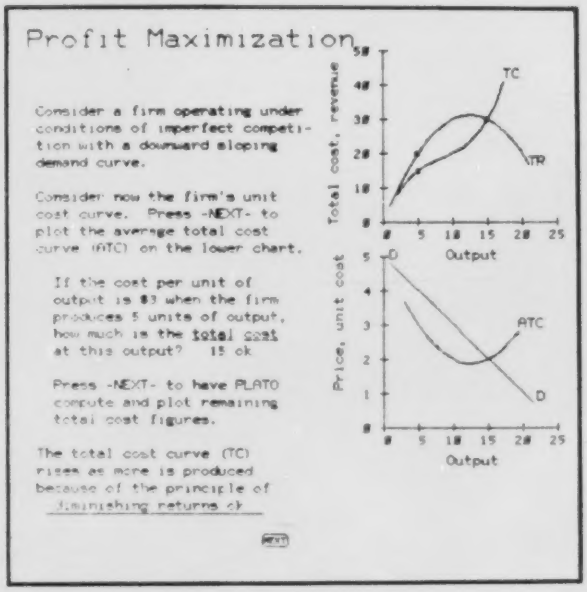

Profit Maximization
Consider a firm operating under conditions of imperfect competition with a downward sloping demand curve.
Consider now the firm's unit cost curve. Press -NEXT- to plot the average total cost curve (ATC) on the lower chart.
If the cost per unit of output is $3 when the firm produces 5 units of output, how much is the total cost at this output? 15 ok
Press -NEXT- to have PLATO compute and plot remaining total cost figures.
The total cost curve (TC) rises as more is produced because of the principle of diminishing returns ok
NEXT
TC
TR
ATC
D
Total cost, revenue
Price, unit cost
Output

Figure 17. Imperfect Competition, by Donald W. Paden, James Wilson, and Michael D. Barr. Copyright © 1975 by the Board of Trustees of the University of Illinois.

The chemistry department is one of the newest users of PLATO, having begun to integrate PLATO into its general chemistry courses during the Spring of 1977. Taking advantage of the large package of chemistry lessons written under NSF funding at the University of Illinois, the chemistry department has enjoyed instant success in helping students learn to determine chemical formulas from the composition by weight, to calculate the percentage composition from the known chemical formula, to determine quantitative relations in chemical equations, to make rapid identification of unknowns, and to perform multiple step organic syntheses for electrophilic aromatic substitution reactions. By using the computer to simulate chemical reactions, students get to work with many more samples than is possible in the traditional chemistry lab. PLATO gives the student the freedom to experiment with many methods of solving a given problem.

Figure 18 shows how experience in rapid identification of unknown organic compounds is provided by a lesson in which the student simply asks questions about the compound. The computer provides instantaneous answers, such as giving the boiling point or showing the NMR spectrum of the unknown compound. The vocabulary of the program is adequate to answer all of the experimentally useful questions about the compound under investigation. Figure 19 shows how PLATO teaches the standardization of an aqueous NaOH solution by simulating acid-base titrations. The student must perform every step in the simulation from filling the buret to observing the change of color at the end of the experiment. PLATO makes sure that the student follows correct laboratory procedures, helping out with suggestions when necessary.

Type your question about the unknown and then press NEXT.
When you have identified the compound press BACK.
> What is the boiling point?
The boiling point is 245 to 247° at 1 atm.
SCORE = 1
For tables of data press DATA. To review press LAB.
For help press HELP.

Figure 18. Qualitative Organic Analysis, by Stanley Smith. Copyright © 1972 by the Board of Trustees of the University of Illinois.

ACID-BASE TITRATIONS
Standardization of an aqueous NaOH solution.
In this experiment you are to determine the concentration of a NaOH solution by titration of potassium acid phthalate (MW = 204).
The base is about 0.1 M.
What do you want to do first?
> fill the buret
Plato is filling the buret for you.
Press s to stop filling
Press f to restart filling.
Fill the buret almost to the top.
For help press HELP. To use a calculator press DATA

Figure 19. Acid-Base Titrations, by Stanley Smith. Copyright © 1976 by the Board of Trustees of the University of Illinois.

A general need of the communication major is skill in the use of at least one system of phonetic transcription. The most effective method of practice for the development of this skill is one involving transcription from oral dictation. Immediate feedback on accuracy significantly increases the rate of development. The communication department has found PLATO to be a good medium for providing this kind of practice. PLATO's random-access audio device is used to give the oral dictation. The use of PLATO to present dictation and judge student responses not only decreases the amount of class time that must be devoted to this activity for all students, but it also offers an opportunity for those who need more practice time to get it without doing so at the expense of the students who do not.

Figures 20 and 21 show some of the strategies used in PLATO's phonetics programs. Figure 20 shows a talking robot program which students use to experiment with the physiology of phonetic production. This program allows the student to move the tongue, velum, and lips in various positions, and at any time the student can find out what sound would be produced. The computer shows the student not only the side view of the robot's head, but also the palatogram. Figure 21 illustrates another strategy in which PLATO gives the description of a consonant and then asks the student to type the corresponding consonant.

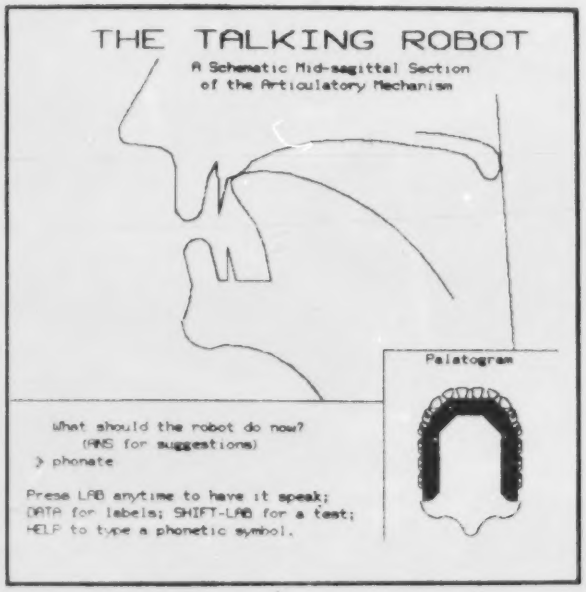

THE TALKING ROBOT
A Schematic Mid-sagittal Section
of the Articulatory Mechanism
Palatogram
What should the robot do now?
(ANS for suggestions)
> phonate
Press LAB anytime to have it speak;
DATA for labels; SHIFT-LAB for a test;
HELP to type a phonetic symbol.

Figure 20. The Talking Robot: A Simulation of Speech Sound Production, by James H. Wilson and Elaine P. Paden. Copyright ©1975 by the Board of Trustees of the University of Illinois.

CONSONANTS: FEATURES+SYMBOLS
fortis alveolar fricative
> z no
The consonant you specified has the following features:
lenis alveolar fricative
Type the consonant, then press NEXT.
Press ANS to give up on one.
Press HELP to see the phonetics keyset.
Press BACK to choose another type of drill.

Figure 21. Organogenetic Feature Drills, by James H. Wilson and Elaine P. Paden. Copyright ©1975 by the Board of Trustees of the University of Illinois.

-Computer Science-

Several graphics classes from the department of statistics and computer science have used PLATO terminals in order to explore the graphical capabilities of the plasma display panel. Students in these classes have been especially interested in PLATO's programmable character sets, ease of software manipulation, and microprocessing capabilities. A proposal has been made to locate a PLATO terminal in Kirkbride Hall and connect it to the video projection system in order that displays drawn on the terminal could be projected onto a large screen. This would enable professors to use the terminal's graphical capabilities in explaining and demonstrating complex phenomena in class. The terminal would be modified so that it could run not only PLATO programs, but also programs run on the university's Burroughs 7700 computer.

-Continuing Education-

The division of continuing education has two goals with respect to PLATO. The first goal is to implement the counseling program being developed by Dr. Richard Sharf. Terminals would be located at the various sites of continuing education's counseling operations: Clayton Hall, Wilcastle Center, Dover Air Force Base, Milford High School, and Georgetown. The second goal is to use PLATO as a mechanism for delivering instruction in education courses. This would include not only the use of pre-programmed materials, but also the development of new materials suited to the needs of continuing education students.

-Counseling-

The Center for Counseling is using PLATO to develop a computer-based career guidance system which allows people to clarify their interests and abilities, and helps them exlore the characteristics of occupations. The system consists of two parts. The first part consists of a computerized version of the Self Directed Search, an interest and ability inventory developed by John Holland (1974). The user spends fifteen to twenty minutes answering 228 items in the six scales of the inventory, namely, realistic, investigative, artistic, social, enterprising, and conventional. Figure 22 shows a sample display from the investigative scale. In this scale, the user indicates whether the activities printed on the screen are liked or disliked by touching the appropriate boxes. The boxes chosen by the user light up.

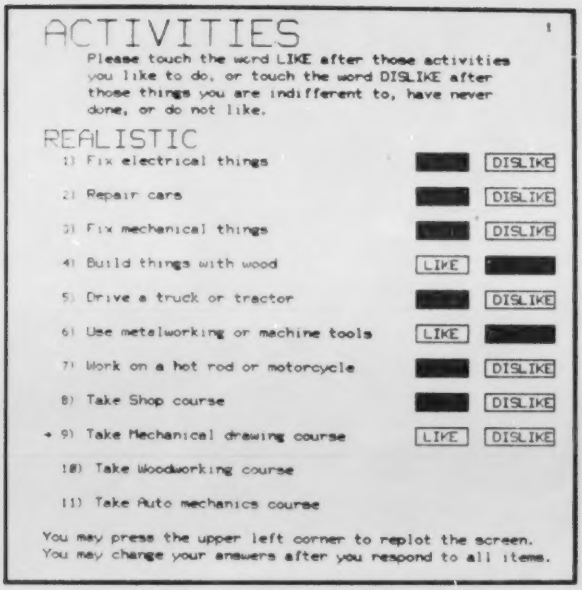

ACTIVITIES
Please touch the word LIKE after those activities you like to do, or touch the word DISLIKE after those things you are indifferent to, have never done, or do not like.
REALISTIC
1) Fix electrical things DISLIKE
2) Repair cars DISLIKE
3) Fix mechanical things DISLIKE
4) Build things with wood LIKE
5) Drive a truck or tractor DISLIKE
6) Use metalworking or machine tools LIKE
7) Work on a hot rod or motorcycle DISLIKE
8) Take Shop course DISLIKE
9) Take Mechanical drawing course LIKE DISLIKE
10) Take Woodworking course
11) Take Auto mechanics course
You may press the upper left corner to replot the screen.
You may change your answers after you respond to all items.

Figure 22. Interest Inventory from The Self Directed Search, by John L. Holland. Copyright © 1977 by Consulting Psychologist Press, Inc.

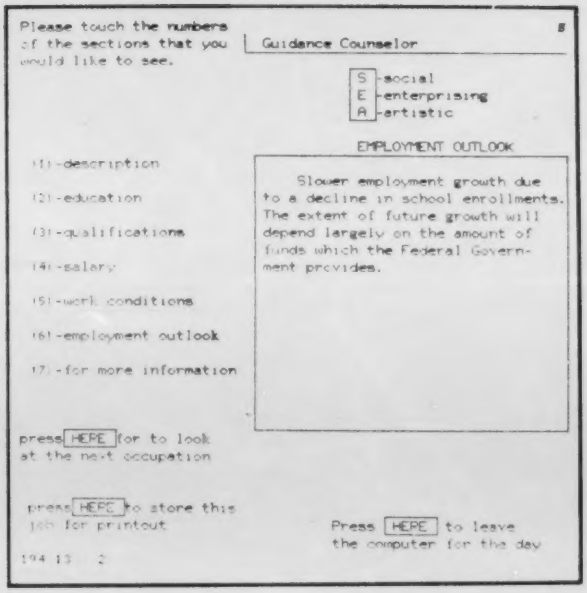

Please touch the numbers of the sections that you would like to see.
Guidance Counselor
S -social
E -enterprising
A -artistic
EMPLOYMENT OUTLOOK
(1)-description
(2)-education
(3)-qualifications
(4)-salary
(5)-work conditions
(6)-employment outlook
(7)-for more information
Slower employment growth due to a decline in school enrollments. The extent of future growth will depend largely on the amount of funds which the Federal Government provides.
press HERE for to look at the next occupation
press HERE to store this job for printout
Press HERE to leave the computer for the day

Figure 23. Occupational Search, by Dr. Richard Sharf. Copyright © 1977 by the University of Delaware PLATO Project.

When the user completes the Self Directed Search, PLATO computes the scores for each of the six inventories. After comparing these scores to a data bank of occupations, PLATO then allows the user to ask questions regarding the occupations. In figure 23 PLATO has been asked to display the employment outlook for the occupation "guidance counselor." The computer memory contains current information on 317 occupations. PLATO allows the user to look at any occupations he wishes to examine, in an order determined by PLATO.

This project differs from other computerized guidance projects in several ways. It begins with an assessment of the individual's interest and abilities using a well-validated inventory, rather than an exploration of a large data base of job information without any direction. Its data base includes occupations for college students and adults returning for further education. Access to the system has been made as simple as possible so that people who have never used a computer terminal can benefit from the system. PLATO is being used not only for the delivery of career guidance, but also for the creation of a data base of information on how people make career choices.

The Center for Counseling views PLATO not only as a resource for students and working adults who are facing career decision, but also as a vehicle for research on how people make such decisions. Hypotheses are being tested regarding the relationships between scores on the inventory scales and the types and amounts of information requested.

-Education-

The College of Education is using PLATO in three different areas: teacher preparation, clinical work with children, and behavioral research.

Pre-service teachers prepare for the classroom of the future by viewing PLATO's materials for elementary and secondary students in math, reading, business, typing, science, and career guidance. Figure 24 shows a sample display from a math lesson in which third grade students learn fractions. In this case they are asked to find 1/8 of 24 bees. The student merely touches a bee on the PLATO screen to "pick it up" and then touches a tub to "drop" the bee into the container. Future high school math teachers also learn how the computer can be used as a tool for teaching trigonometry. Figure 25 shows a lesson in which students can write their own programs containing functions such as $y=\sin(x^2)+\sin(x)$ and have PLATO graph them.

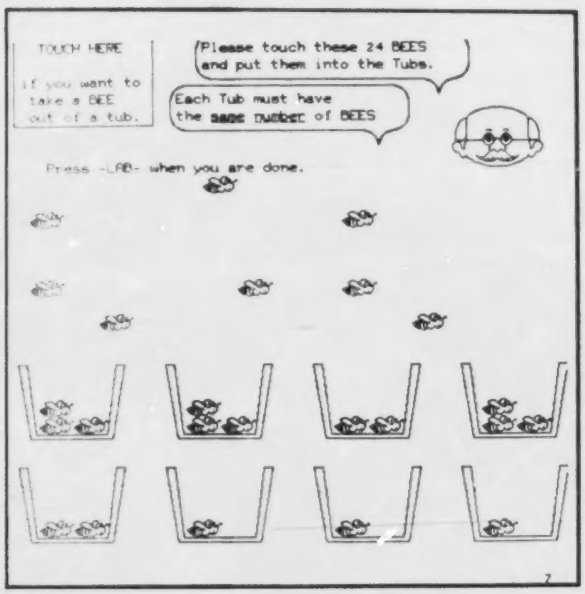

TOUCH HERE
if you want to take a BEE out of a tub.
Please touch these 24 BEES and put them into the Tubs.
Each Tub must have the same number of BEES
Press -LAB- when you are done.

Figure 24. Animal Bagger, by Bonnie Anderson Seiler. Copyright © 1976 by the Board of Trustees of the University of Illinois.

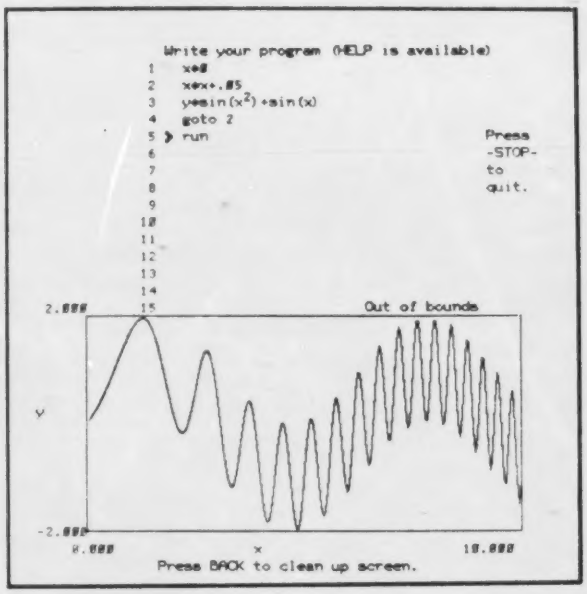


Figure 25. Grafit, by Bruce Sherwood. Copyright © 1971 by the Board of Trustees of the University of Illinois.

Business education majors learn how PLATO can assist in teaching accounting and typing skills. When students do typing exercises on PLATO, their errors are closely monitored by the computer, as illustrated in figure 26. Typists at all levels become hooked on PLATO's speed typing games, such as the one shown in figure 27. The lesson keeps track of each student's progress throughout the semester and also lists the fastest typists in its "Hall of Fame."

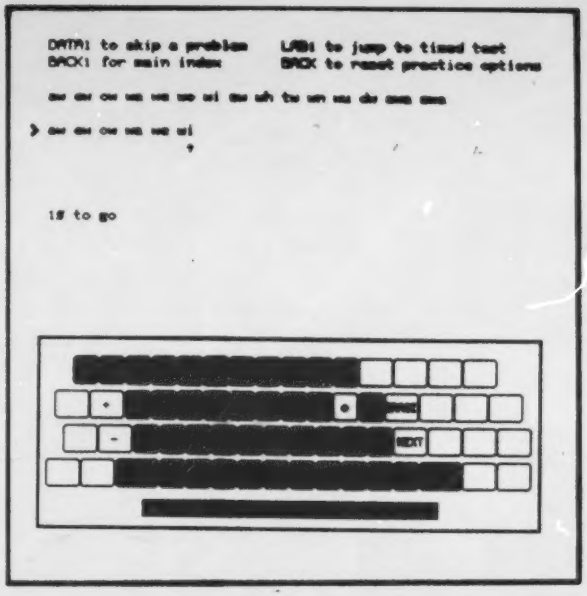
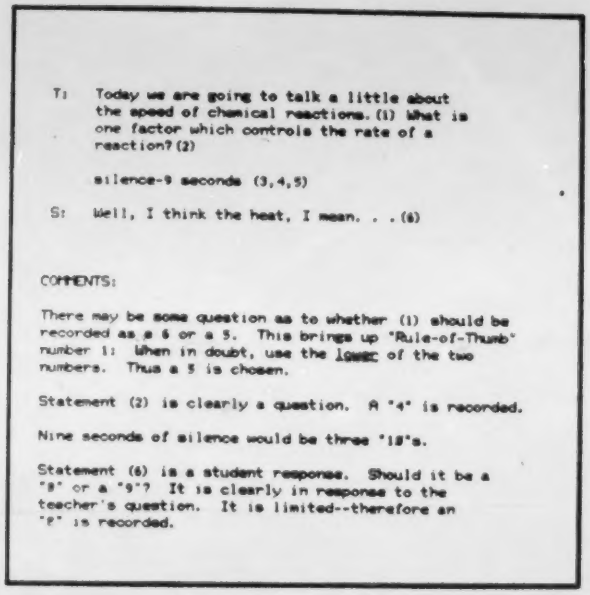


Figure 26. The Dvorak Simplified Keyboard, by John D. Eisenberg.

idea single got gum week nothing select yellow
idea single got gum week nothing select yellow
sorry lobby jacket sign spring sharp happy hole
sorry lobby jacket sign spring sharp happy hole
humane please air case mole beer message catch
humane please air case mole beer message catch
ocean sudd tree jelly study hate valley game
ocean sudd tree jelly study hate valley game
rabbit rear youth explain speak watch disturb
rabbit rear youth explain speak watch disturb
wish crooked mental bag flowers boyish camping
wish crooked mental bag flowers boyish camping
hippy guess job zipper white diagonal cardinal
hippy guess job zipper white diagonal cardinal
little
little
You did 59.35 words per minute.
And you beat your best for today of 51.57 wpm.
Number of errors=5. Corrected wpm=54.4.
Press DATA for statistics.

Figure 27. Lesson Debugs, by Marshall Midden. Copyright © 1975 by the Board of Trustees of the University of Illinois.

Several teaching simulations provide education majors with an opportunity to diagnose reading difficulties, use behavior modification techniques, analyze classroom interaction, and make everyday decisions in a simulated high school. Figure 28 shows a lesson whereby students learn Flanders' classification scheme for interactions that take place in the classroom. Later in the lesson, students enter data on actual student-teacher dialog, as shown in Figure 29, and then analyze teaching technique.



T: Today we are going to talk a little about the speed of chemical reactions. (1) What is one factor which controls the rate of a reaction? (2)

silence-9 seconds (3,4,5)

S: Well, I think the heat, I mean. . . (6)

COMMENTS:

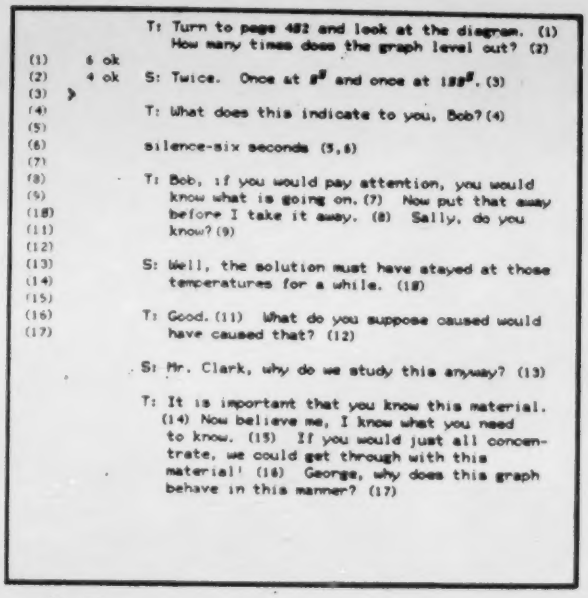
There may be some question as to whether (1) should be recorded as a 6 or a 5. This brings up 'Rule-of-Thumb' number 1: When in doubt, use the lower of the two numbers. Thus a 5 is chosen.

Statement (2) is clearly a question. A "4" is recorded.

Nine seconds of silence would be three "15"s.

Statement (6) is a student response. Should it be a "8" or a "9"? It is clearly in response to the teacher's question. It is limited--therefore an "8" is recorded.

Figure 28. Flanders Interaction Analysis, by Owen F. Gaede, Department of Secondary Education, Georgia Southern College. Copyright © 1976 by the Board of Trustees of the University of Illinois.



T: Turn to page 482 and look at the diagram. (1) How many times does the graph level out? (2)

(1) 6 ok
(2) 4 ok
(3) >

S: Twice. Once at 8° and once at 155°. (3)

(4)
(5)
(6)

T: What does this indicate to you, Bob? (4)

silence-six seconds (5,6)

(7)
(8)
(9)
(10)
(11)
(12)

T: Bob, if you would pay attention, you would know what is going on. (7) Now put that away before I take it away. (8) Sally, do you know? (9)

(13)
(14)
(15)
(16)
(17)

S: Well, the solution must have stayed at those temperatures for a while. (10)

T: Good. (11) What do you suppose caused would have caused that? (12)

S: Mr. Clark, why do we study this anyway? (13)

T: It is important that you know this material. (14) Now believe me, I know what you need to know. (15) If you would just all concentrate, we could get through with this material! (16) George, why does this graph behave in this manner? (17)

Figure 29. Flanders Interaction Analysis student-teacher dialogue, by Owen F. Gaede, Department of Secondary Education, Georgia Southern College. Copyright © 1976 by the Board of Trustees of the University of Illinois.

The extensive statistics package on PLATO gives students in upper and lower level statistics courses a chance to see dynamic graphic illustrations of concepts and procedures. For example, figure 30 shows how in a lesson on the normal curve students can study the effect of using different values for the mean and standard deviation.

Faculty and graduate students at the Reading Study Center are exploring the potential of computer-based education for a remedial reading clinic environment. They have become familiar with the lessons written for young children at the University of Illinois, and they have been using and evaluating these lessons with older children who use the Reading Study Center. They are also developing new lesson material designed specifically for remedial reading. Figure 31 shows a sample display from an imitative reading program which uses PLATO's random access audio device to read stories aloud to the student. The child follows along, line by line, as PLATO reads the story. Then the student reads along with PLATO. Finally, the student reads each line on his own. A special feature of this program is that the lines are "touch sensitive," meaning that the student can get PLATO to read any line he wants by simply touching it with his finger. Seventeen stories are currently available, spanning reading levels 1 through 6.

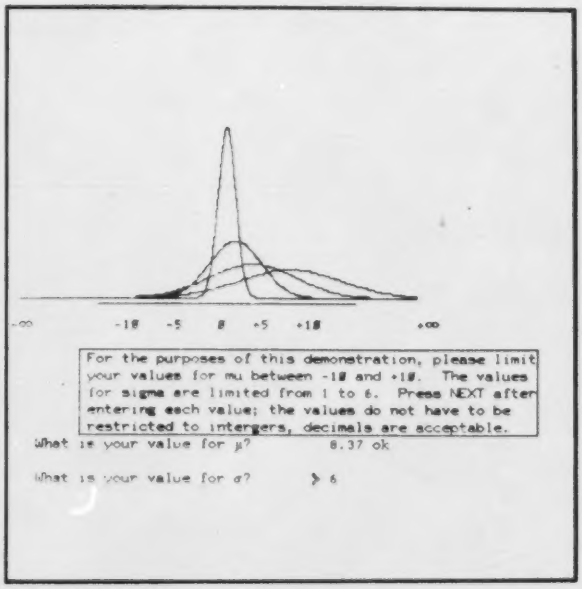

-∞ -1Ø -5 Ø +5 +1Ø +∞
For the purposes of this demonstration, please limit your values for mu between -1Ø and +1Ø. The values for sigma are limited from 1 to 6. Press NEXT after entering each value; the values do not have to be restricted to intergers, decimals are acceptable.
What is your value for μ? 8.37 ok
What is your value for σ? > 6

Figure 30. Transformations, Z-scores and the Normal Curve, by Jerry L. Cohen and Staff. Copyright © 1974 by the Board of Trustees of the University of Illinois.

Meet Mr. Possum
Page 1
The possum is a funny looking animal.
He looks like a rat and a monkey and a kangaroo too.
The possum has a fur coat. His fur is black and white.
He looks like a very big rat with a long nose.
The possum's tail is like a monkey's tail.
But it has no fur. It helps him to hang on to trees.
Not many animals have a pocket like a kangaroo.
But the possum does. The pocket is called a pouch.
Touch here to continue
Touch here to hear this line again

Figure 31. Read Along with PLATO, by Peter Pelosi. Copyright © 1977 by the University of Delaware PLATO Project.

Figure 32 is a display from the "penny words" lesson. In this lesson the student is given two words at the top of the screen, and a row of pennies at the bottom. Behind the pennies is written one of the words which appears at the top of the screen. By touching a penny, the student can see the letter hidden behind that penny. The object of the lesson is for the student to guess the hidden word without uncovering all of the letters. In figure 32 the student has uncovered enough letters to tell that the hidden word is "net."

The college is also conducting basic perceptual research using various modes of presenting stimuli and recording responses available on the PLATO system. Figure 33 is a sample page from one phase of an experiment concerning the perception of graphs. The student rates the similarity of graphs in all possible pairings of 8 graphs differing in scale, spatial configuration and labeling.

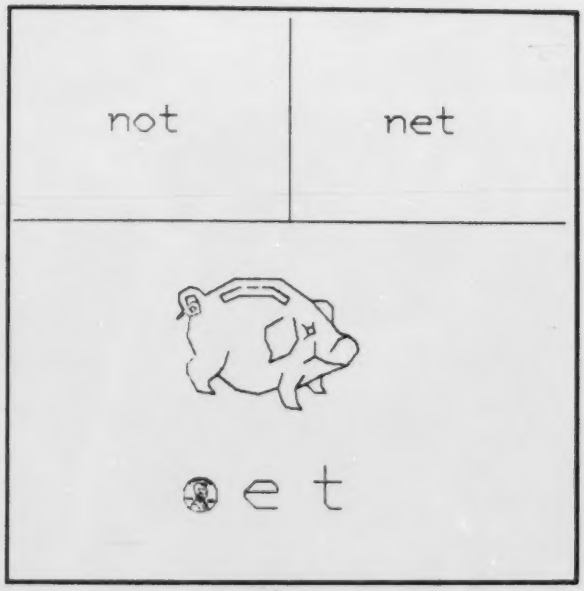


Figure 32. Penny Words, by The PLATO Elementary Reading Group, University of Illinois, under NSF contract C723. Copyright © 1977 by the Board of Trustees of the University of Illinois.

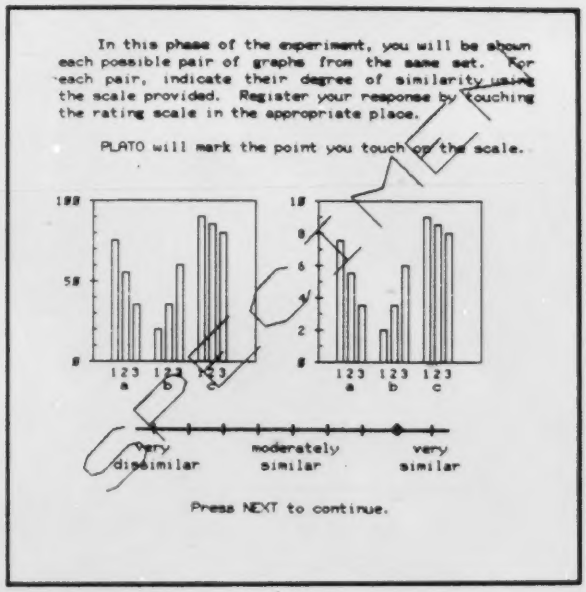

In this phase of the experiment, you will be shown each possible pair of graphs from the same set. For each pair, indicate their degree of similarity using the scale provided. Register your response by touching the rating scale in the appropriate place.
PLATO will mark the point you touch on the scale.
100
50
0
8
6
4
2
0
1 2 3 1 2 3 1 2 3
a b c
1 2 3 1 2 3 1 2 3
a b c
very dissimilar
moderately similar
very similar
Press NEXT to continue.

Figure 33. A routine for collecting Multidimensional Scaling Data to Study the Distinctive Featues of Various Types of Tabular and Graphical Data Displays, by Victor R. Martuza. Copyright © 1977 by the University of Delaware PLATO Project.

The English Department has found PLATO to be a valuable tool for improving writing skills, especially for those students taking the three credit, pre-E110 course taught by the Writing Center staff which used feedback from PLATO to individualize student programs both on the computers and in the small groups of four students per instructor taught at the Writing Center. During the past year nine groups of thirty-eight students, drawn from a possible population of 380, have used PLATO for one hour each week. Designed and put on PLATO by community college English teachers in Illinois, the lessons cover punctuation, sentence structure, spelling, paragraph structure, verbs, and verb form. They also include diagnostic programs which gather information on individual students' skills in several areas of usage and punctuation.

Figure 34 shows a simple drill in which the student is asked to identify parts of speech in a sentence. In this example the student was first asked to identify the pronoun in the sentence; the student correctly answered "their." The student was then asked to identify that pronoun's antecedent; the student correctly answered "children," and was appropriately congratulated. A special feature of this lesson is the interactive help which students receive when they answer incorrectly. In this example if the student had answered "are" instead of "their," PLATO would have told him that "are" is a verb, not a pronoun.

Figure 35 shows a more complex exercise in which the student is given a paragraph which contains misused words. The student is asked to identify and correct the misused words. When a misused word has been corrected, PLATO crosses it out and prints the correct word above it. In the example given the student has already corrected the words "they're" and "which" and "Irregardless," and is now changing "hisself" into "himself."

Figure 34. Pronoun Agreement, by Delores Lipscomb. Copyright © 1976 by the University of Illinois at Chicago Circle.

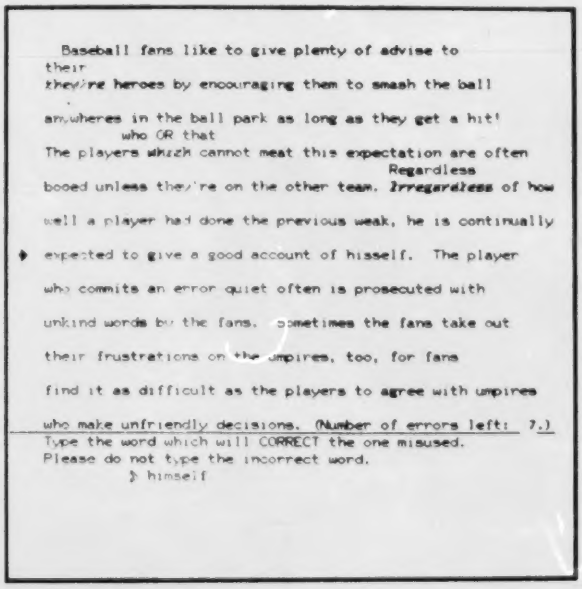

Baseball fans like to give plenty of advise to
their
they're heroes by encouraging them to smash the ball
anywheres in the ball park as long as they get a hit!
who OR that
The players whizh cannot meat this expectation are often
Regardless
booed unless they're on the other team. Irregardless of how
well a player had done the previous weak, he is continually
expected to give a good account of hisself. The player
who commits an error quiet often is prosecuted with
unkind words by the fans. Sometimes the fans take out
their frustrations on the umpires, too, for fans
find it as difficult as the players to agree with umpires
who make unfriendly decisions. (Number of errors left: 7.)
Type the word which will CORRECT the one misused.
Please do not type the incorrect word.
⟩ himself

Figure 35. Paragraph Editing: Word Usage, by Errol M. Magidson and Mitsuru Yamada. Copyright © 1974 by the City College of Chicago.

Faculty members in the areas of clothing construction, home economics education, foods, interior decoration, retailing, and flat pattern have become interested in the teaching and research potential of the PLATO system. Prior to the start of their project the only home economics lesson on the system dealt with nutrition. At the present time they are developing lessons in both measurement, pattern measurement, ease requirement, alteration practice, fitting, determining pattern size and figure type, and determining needed alterations.

One of their criteria in lesson development has been to make full use of the special features of PLATO. The touch panel is used in teaching the location of body measurements. In this lesson the student is presented with a line drawing of a human body. The student is instructed to touch the screen to indicate the beginning and ending points for the requested measurement, as shown in Figure 36. If the cursor which appears on the screen is not exactly where the student wishes it to be, the student can move the cursor by pressing any one of the eight directional keys.

Microfiche slides will be used to teach students how to determine needed alterations. Ill-fitted garments will be projected on the screen, and the student will be asked to identify and correct the problem. If the student answers correctly, the correct fit will be shown. In some cases, the results of incorrect answers can be shown as well. Figure 37 shows the measurement chart which students fill in to determine what alterations they need.

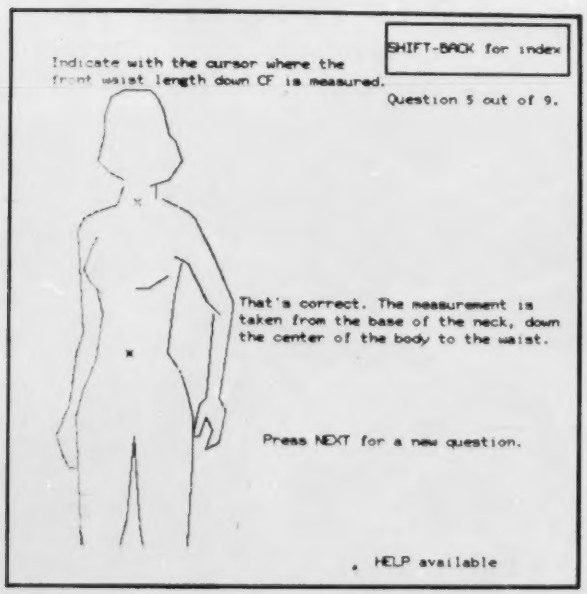

SHIFT-BACK for index
Indicate with the cursor where the front waist length down CF is measured.
Question 5 out of 9.
That's correct. The measurement is taken from the base of the neck, down the center of the body to the waist.
Press NEXT for a new question.
HELP available

Figure 36. Body Measurement, by Dorothy K. Elias, Frances W. Mayhew, and Frances K. Smith. Copyright © 1976 by the University of Delaware PLATO Project.

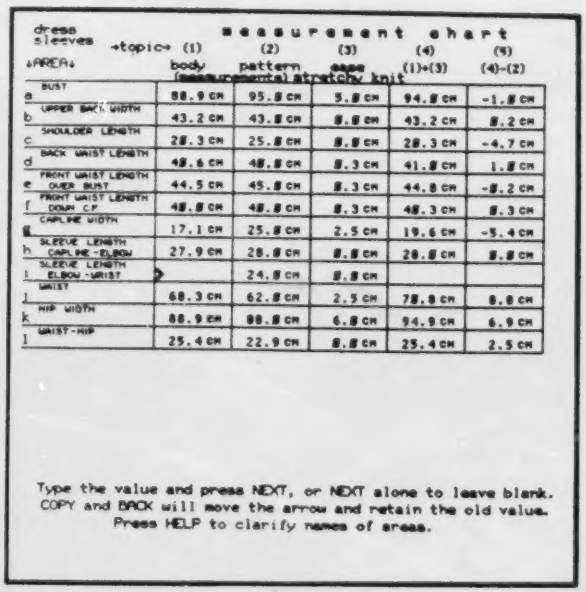

dress sleeves
measurement chart
topic (1) body (2) pattern (3) ease (4) (1)+(3) (5) (4)-(2)
AREA
(measurements stretchy knit)
a BUST 88.9 CM 95.8 CM 5.8 CM 94.8 CM -1.8 CM
b UPPER BACK WIDTH 43.2 CM 43.8 CM 8.8 CM 43.2 CM 8.2 CM
c SHOULDER LENGTH 28.3 CM 25.8 CM 8.8 CM 28.3 CM -4.7 CM
d BACK WAIST LENGTH 48.6 CM 48.8 CM 8.3 CM 41.8 CM 1.8 CM
e FRONT WAIST LENGTH OVER BUST 44.5 CM 45.8 CM 8.3 CM 44.8 CM -8.2 CM
f FRONT WAIST LENGTH DOWN CF 48.8 CM 48.8 CM 8.3 CM 48.3 CM 8.3 CM
g CAPLINE WIDTH 17.1 CM 25.8 CM 2.5 CM 19.6 CM -5.4 CM
h SLEEVE LENGTH CAPLINE-ELBOW 27.9 CM 28.8 CM 8.8 CM 28.8 CM 8.8 CM
i SLEEVE LENGTH ELBOW-WRIST 24.8 CM 8.8 CM
j WAIST 68.3 CM 62.8 CM 2.5 CM 78.8 CM 8.8 CM
k HIP WIDTH 88.9 CM 88.8 CM 6.8 CM 94.9 CM 6.9 CM
l WAIST-HIP 25.4 CM 22.9 CM 8.8 CM 25.4 CM 2.5 CM
Type the value and press NEXT, or NEXT alone to leave blank.
COPY and BACK will move the arrow and retain the old value.
Press HELP to clarify names of areas.

Figure 37. Determining Needed Alterations, by Dorothy K. Elias and Frances K. Smith. Copyright © 1976 by the University of Delaware PLATO Project.

Languages faculty members have worked very hard to successfully improve instruction in Latin, Spanish, French, and German. A problem common to courses in all four of these languages is the wide variation in knowledge of English grammar possessed by beginning students. About half of the students do have an adequate knowledge; but many of the others are so weak in English grammar that they need an intensive review of English before they can begin to learn a foreign grammar. In order to solve this problem the languages department has programmed an English grammar review for those students who need it. Part of the review consists of substitution drills, such as the one shown in figure 38. PLATO gives the student a sentence such as "Sam got lost in the fog yesterday." PLATO then changes the word "yesterday" to "tomorrow" and asks the student what other words need to be changed to fit the substitution. In this case the word "got" needs to be changed to "will get."

The languages department is also using PLATO to deliver instruction in foreign languages themselves. Figure 39 shows a sample Latin translation question. The student has been asked to translate the sentence "Senectus est loquacior." The student's answer is "Old age, rather, is talkitive." Notice that instead of just telling the student that the answer is wrong, PLATO gives the student information regarding why the answer is wrong and what must be done to fix it. The △ before the word "rather" means that a word is missing here. The ⇐ under the word "is" tells the student that the word is out of order, and should appear earlier in the sentence. The equal signs under the word "talkitive" means that it is misspelled.

Sam
got
lost
in
the
fog
yesterday
What OTHER words will change?
Put boxes around them.
Careful! You only want words that are grammatically forced to change, by the changes the student was told to make.
(Also include words that don't always change. Words with no markings should never change in this drill.)
NEXT when done.
EXAMPLE:
QUESTION:
I'm sure she knows her conjugations.
[they]
ANSWER:
I'm sure they know their conjugations.

Figure 38. Substitution Drill Maker, by Dan Williams. Copyright © 1976 by the Delaware PLATO Project.

Translate the sentence into English. Use vocabulary supplied.
(12 to go)
Senectus est loquacior.
} Old age, △rather, is talkitive. no
Press DATA if you want to see the answer.
senectus,-us(m)=old age
esse=to be
loquax,loquacis=talkative

Figure 39. Beginning Latin, by Richard T. Scanlon. Copyright © 1976 by the Board of Trustees of the University of Illinois.

Figure 40 is from a lesson which teaches Spanish culture--in Spanish! The lesson begins with a simple vocabulary which grows and becomes more complex as the semester progresses. New words appear with numbered superscripts. If the student doesn't know the word, he can type the number associated with the word to learn its meaning. The student is tested from time to time on his knowledge of Spanish vocabulary and cultural heritage.

The language courseware has also demonstrated a distinct advantage of the PLATO system, namely, its flexibility of educational delivery. One of our students expressed a need to learn Chinese, a course for which there was not sufficient student demand to offer in the curriculum. That student was able to fulfill his specific learning need by taking a course in Chinese at a PLATO terminal.

Figure 40. Introduction to Spanish Culture, by Armando Armengol and Brian Dutton. Copyright © 1976 by the Board of Trustees of the University of Illinois.

The music department has developed a package of ear-training programs called "GUIDO." Guido d'Arezzo is the eleventh century musician and music educator who invented the staff and established the principles of solmization. The ear-training programs are named after him, using his first name as an acronym for Graded Units for Interactive Dictation Operations. The entire first year of ear-training materials has been organized according to levels of difficulty into graded units which form the basis of a competency-based curriculum including drill and practice in intervals, melodies, chords, harmonies, and rhythms. Ear-training students spend an average of two hours each week at GUIDO learning stations which consist of a PLATO terminal and a digital synthesizer designed and developed by Sherwin Gooch at the University of Illinois.

The basic design of the GUIDO programs consists of a three-part process whereby PLATO first displays an answer form on the terminal screen, second, plays a musical example using the digital synthesizer, and third asks questions about the students' perception of the example. PLATO keeps track of how well the students are doing and issues weekly progress reports to the instructors.

Figure 41 shows a sample display from the intervals program. By studying this display the basic features of the GUIDO system can be understood. At the top are two rows of boxes which contain the names of musical intervals. When the student wants to hear an interval, all he has to do is touch one of the boxes. When he does, the box lights up and the interval designated by the box is played by the computer-controlled synthesizer. Conversely, when the student is going through one of GUIDO's formal units, the computer plays an interval, and the student responds by touching the box which contains the interval he thinks was played.

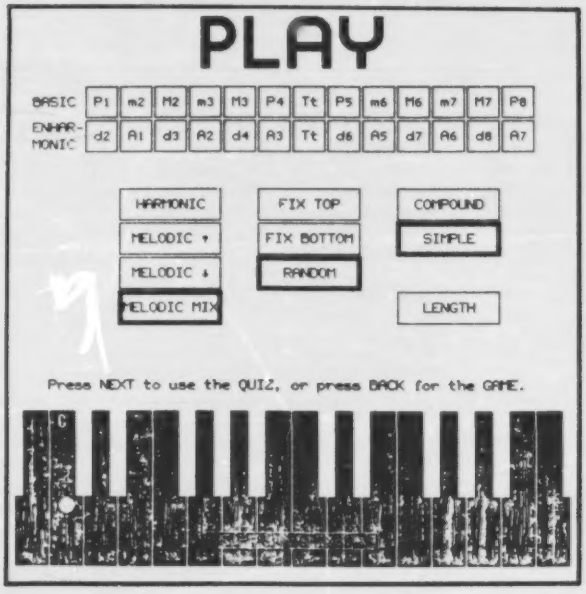


Figure 41. GUIDO Intervals Program,
by Fred T. Hofstetter and William H. Lynch.
Copyright © 1977 by the Delaware PLATO Project.

Underneath the interval names are three columns of teacher or student control boxes. These boxes are used to control the way in which dictation is given. The teacher can preset them for the student, or the teacher can allow the students to set them at will. The first column of boxes allows for the intervals to be played as harmonic, melodic up, melodic down, or melodic intervals up and down. The second column gives the option of being able to fix the top or bottom note of the intervals, or to have them selected at random. The box marked "intervals" allows the student to eliminate intervals from the boxes at the top of the screen, so that only some of the intervals will be played. In the third column of boxes the student can select compound or simple intervals, can have an interval played again, and can change the length of time the intervals last. Finally, there is a keyboard at the bottom of the screen. When intervals are played in formal units one of the notes of each interval is shown on the keyboard, and the student is asked to touch the other note played in the interval. In this way, students are quizzed on the spelling as well as on the aural recognition of intervals.

The music department is also developing lessons for use in the written aspects of music, both at the beginning and advanced levels. Figure 42 shows a sample display from a note reading drill. In this lesson PLATO randomly selects a clef and a note, and then asks the student to name the note as fast as possible. PLATO keeps score and maintains a rank-order list of the fastest students in the class. Students are motivated by trying to climb to the top of the list. Figure 43 shows how students in advanced harmony can obtain names for pitch class sets in twentieth century music. After the students enter the pitches, PLATO puts them in normal form and performs the appropriate table look-ups.

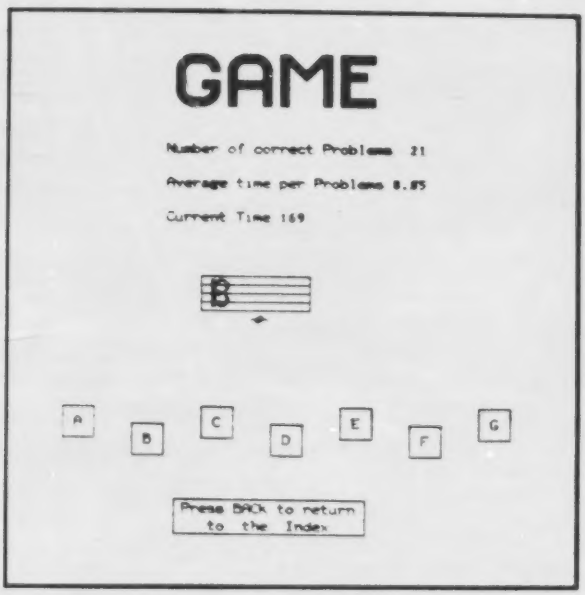


Figure 42. Music Fundamentals, by Peter J. McCarthy. Copyright © 1977 by the Delaware PLATO Project.

Figure 43. Set Theory Program, by James Trueblood. Copyright © 1976 by the Delaware PLATO Project.

The College of Nursing is realizing the potential of PLATO to deliver instruction in courses dealing with adult physical health and illness, maternal and child health nursing, and adult acute physical illness. Through membership in PLATO's Health Science Network, the College is using programs developed at the University of Illinois, Sheppard Air Force Base, the University of Oklahoma, and Parkland Community College. The college is also developing its own programs for educating nurses in the care of clients and families with a variety of problems and the handling of emergency situations.

The nursing programs include both tutorials and simulations. Figure 44 shows a sample display from the tutorial on the problem oriented medical record. PLATO guides the students through a sequence of these tutorials, which develop skill at gathering and classifying information important to the care of people. Physical examinations are simulated in the computer. For example, figure 45 shows how the student can stimulate eyes and observe the pupillary eye reflex. The student can also practice caring for the patient in a simulated environment.

sobicoff
In response to your first question, Mrs. Patience says, "I've been coughing up blood!" Is that SUBJECTIVE or OBJECTIVE information? ("s" or "o")
: s
Right! She's TELLING you about her problem. This is HISTORY.
(-HELP- is available)

Figure 44. Problem Oriented Medical Record, by David Stutz and Jim Romancheck. Copyright © 1976 by the School of Health Care Sciences, Sheppard Air Force Base.

RIGHT EYE
LEFT EYE
STIMULUS
Press the number of the eye you wish to stimulate.
: 2 1. left
2. right
You can stimulate the other eye after about 4 seconds.
Press -BACK- when you have finished your exam.
Press -HELP- if you need it.

Figure 45. Pupillary Light Reflex, by A. Marshall, L. C. Helper, and John Silver. Copyright © 1974 by the Board of Trustees of the University of Illinois.

By using PLATO the nursing students practice assessing, planning, implementing, and evaluating a client/family centered plan which often cannot be found in the hospital on a regular basis. Emergency experience is simulated in a real life environment where every second counts. Students get to try out many methods of intervention, and can compare the results. They can care for the same patient several times, since the patient is simulated in the computer.

-P.S. DuPont High School-

As part of a joint project by the Wilmington Public School District and the University of Delaware, a PLATO terminal was placed at P.S. DuPont High School for the 1976-77 school year. The purpose of the project was to investigate ways in which computer-based instruction via the PLATO system could benefit an urban high school. Funds for the terminal, computer time, and telephone lines to Illinois were provided by the University of Delaware and the University of Illinois at Urbana-Champaign. Sixteen teachers from ten academic areas shared the terminal and used it in a variety of ways.

The terminal was placed in a regular classroom and was scheduled period by period. It was used five to six hours each day, for a total of 790 terminal contact hours. Use varied greatly; sometimes an entire class of 30 students used the terminal together by having half of the students team up against the other half in an instructional game. At other times a large class worked in the room at regular seatwork while small groups of students took turns at the terminal with the teacher. Frequently, small groups of from five to nine students worked through and discussed a PLATO lesson together with the teacher.

Other uses of the terminal involved students working without a teacher present. Sometimes teachers sent from one to three students to the PLATO room to work at assigned lessons. Ms. Debbie Braendle, an undergraduate student at the University of Delaware and a member of the PLATO staff, was present one day each week to help individuals and groups. This worked especially well for the students in special education classes.

When the PLATO terminal was not in use by someone from the scheduled class, unscheduled students "dropped in" to use PLATO. One teacher said that some students cut class to use PLATO. They even jimmied the locks and smashed the windows in the door in order to gain access to PLATO.

Throughout the year, the teachers at P.S. DuPont experimented with different ways to share one terminal with hundreds of students. In general, they felt that the most successful schemes were: (1) small group instruction with a teacher or aid; and (2) individual or partner use if an aid or teacher is available to handle problems.

Teacher Reaction. In evaluating the PLATO experience at the end of the school year, the teachers unanimously praised the quality of the materials available on the PLATO system. They said they found ample material that was appropriate for high school students, especially for those students in special education and for those in advanced courses.

Teachers were pleased by students' willingness to read what was presented on the computer screen, to work out answers, and to help one another. They said that some students who generally refuse to read nevertheless read the directions in PLATO lessons without coaxing. An educational game, whether in English, math, or some other subject, can create a situation in which the student needs to read in order to play. For his efforts, he is constantly rewarded through lively interaction with the computer.

Otherwise unmotivated students found PLATO fascinating. Teachers were able to extend this enthusiasm to activities away from the terminal, such as compositions on the benefits of computers, written evaluations of lessons, and students' own ideas for educational games that could be put on PLATO.

Most of the improvements in learning were not measured formally. One English teacher gave a test to her students on the parts of speech before and after they used a PLATO lesson on the topic; she was very pleased with the gains. Math teachers noted their students' steadily improving scores on timed arithmetic computation that was part of math games.

Student Reaction. The students were very enthusiastic about PLATO. The terminal never sat unused if they could help it. By far, their main comment was "it makes learning fun." In English compositions about PLATO, students wrote:

"It does all kinds of school subjects in a fun kind of way."

"You can use PLATO for many things, such as finding answers to a question, make a question, and then find the answer."

"It will help ones who might not like reading to enjoy reading and work more."

"I liked it because it gave you examples of the types of work you're doing."

"We'd have less absent students or cutting class."

"We should have more terminals in school, if possible one in every classroom."

Lack of sufficient terminal time has slowed the progress of the physical education project, but with the recent acquisition of additional equipment full-time development of the project has resumed. Existing Illinois lessons in kinematics, projectile motion, and biomechanics have been selected to provide the core of non-laboratory instruction for several introductory courses required of physical education majors. These lessons teach important concepts which the students need to apply in their activities. For example, figure 46 shows a display from a tennis lesson. The student can specify the height, angle, and force with which a tennis ball is served, and then can observe the results of the serve on a simulated tennis court. By repeating this simulation with different values for the three variables, the student can develop a conceptual framework for how height, angle, and force affect the tennis serve.

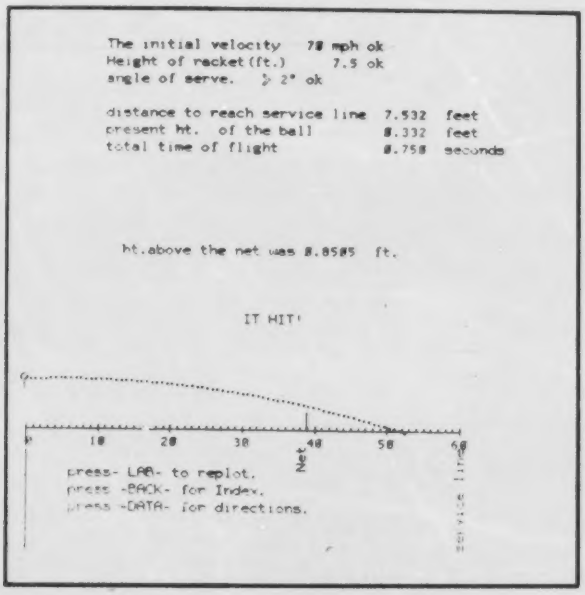


Figure 46. Projectile Motion in Sports Skills, by Robert M. Reece and Charles Dillman. Copyright © 1974 by the Board of Trustees of the University of Illinois.

The division of physical education is also considering the development of a program to help people attain and maintain physical fitness. This program would monitor the progress of an individual during training, and the effects of different activities would be quantitatively and qualitatively evaluated. Development of real-time peripherals, such as pulse rate monitors, is also being explored in connection with this program.

One of the problems encountered by the physics department is that there has traditionally been a group of students with weak backgrounds that do not do well in general physics. During the fall of 1976, the department made available to those students a package of twenty classical mechanics lessons to supplement the normal instruction in the course. Topics included in the lessons were vectors, kinematics, relative motion, momentum, free-body diagrams, torque and angular momentum. The students also had access to quizzes in order to prepare for examinations. It was found that at the end of the course there was no measurable difference between the average scores of the poor students who had used PLATO and the other students in the class. The written comments made by the PLATO students were all positive; a few students thought that PLATO was the greatest thing in learning physics.

Figure 47 shows a sample display from "The Ring Game," a physics lesson in vectors. Two forces act on the ring to move it away from the center of the larger circle. The student's objective is to determine a third, counterbalancing force which will stabilize the ring in the center. Working by trial-and-error compounds the problem. The student has available a "help" page on which appropriate formulas are listed and calculations can be performed.

Figure 48 shows how students can plot points in their study of graphical kinematics. A velocity curve is built, and the student computes the slope of the tangent at a given point and studies how this slope changes under different conditions.

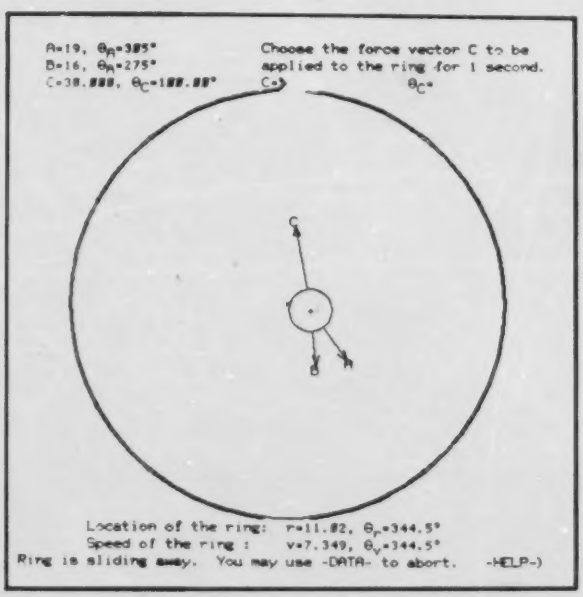

A=19, θA=305°
B=16, θB=275°
C=38.888, θC=188.88°
Choose the force vector C to be applied to the ring for 1 second.
C=
θC=
Location of the ring: r=11.82, θr=344.5°
Speed of the ring : v=7.349, θv=344.5°
Ring is sliding away. You may use -DATA- to abort. -HELP-)

Figure 47. Ring Game: Exercise in Balancing Forces, by Carol Bennett. Copyright © 1975 by the Board of Trustees of the University of Illinois.

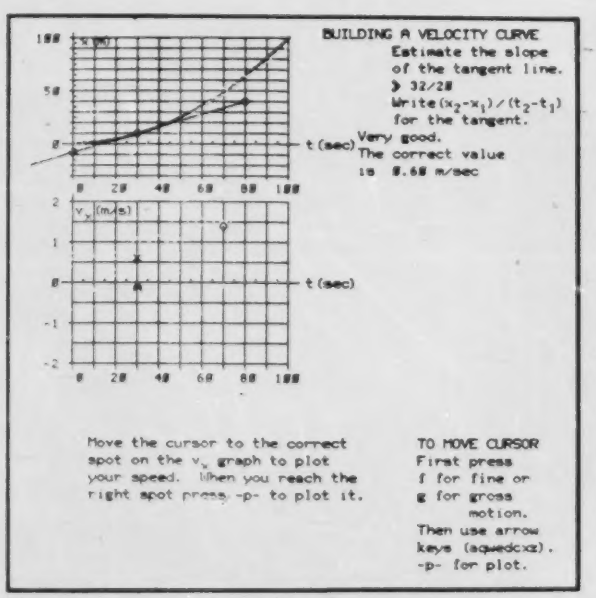

BUILDING A VELOCITY CURVE
Estimate the slope of the tangent line.
› 32/28
Write (x2-x1)/(t2-t1) for the tangent.
Very good.
The correct value is 8.68 m/sec
t (sec)
Move the cursor to the correct spot on the vx graph to plot your speed. When you reach the right spot press -p- to plot it.
TO MOVE CURSOR
First press
f for fine or
g for gross motion.
Then use arrow keys (aquedcxz).
-p- for plot.

Figure 48. Graphical Kinematics, by E. B. McNeil. Copyright © 1973 by the University of Illinois at Chicago Circle.

During the past year the psychology department has been investigating two uses of the PLATO system, namely, its use as an instructional delivery system, and its use as a sophisticated research tool. Students in a course on learning and motivation have been using PLATO programs to study multiple probability learning, verbal and non-verbal memory, short term memory, visual imagery, operant conditioning, neural networks, and complex statistical routines. For example, figure 49 shows how a horse race track provides the setting for a lesson on the role of learning in the subjective assessment of probability. The student is provided with 3 items of information about the contestants in each race, and is asked to bet a variable amount of money. After several races, the student analyzes his performance trends.

The department is also developing its first research program incorporating PLATO as an interactive stimulus-giving, response-storing device. The purpose of the research is to collect information on the strategies used by students in memorizing a large list of words. Students are able to arrange the words at will on the display screen by simply touching a word to "pick it up" and touching a location on the screen to "put it down." The computer will record data regarding the way in which the student arranges the words on the screen, the words that are remembered by the students after a ten-minute study period and then again after one week, and the position on the screen of the words recalled by the student.

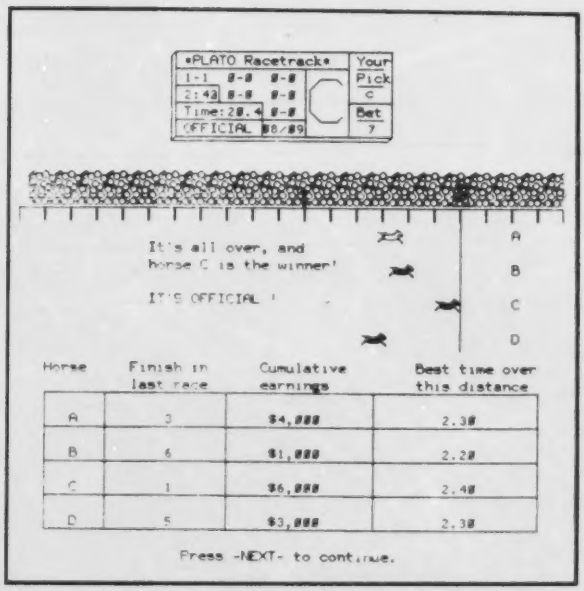


Figure 49. Multiple Probability Learning, by Jerry Cohen. Copyright © 1974 by the Board of Trustees of the University of Illinois.

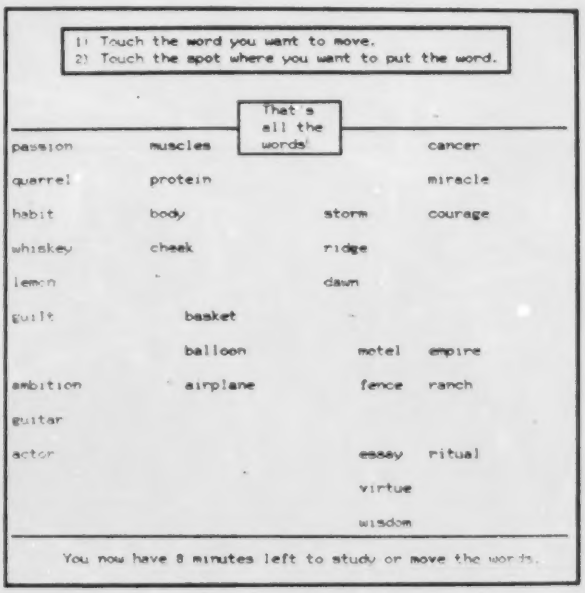


Figure 50. Memory Research, by John McLaughlin. Copyright © 1977 by the University of Delaware PLATO Project.

-Theatre-

After more than a year of planning, full-time programming was begun on the theatre project in June of 1977. The primary lesson under development is an interactive timeline. The purpose of the lesson is to help students gain a better understanding of the history of theatre and of the historical relationship of theatre to other arts and the sciences. Figure 51 shows a sample display from the timeline lesson. Students touch appropriate places on the display in order to move forward and backward in time, to see events from a particular nation or from a particular discipline, and to specify the level of detail they want. For example, the student can ask what happened in Germany during the Baroque in order to learn the most important events of that period, or they can ask what happened in Germany in 1750 to learn events in a particular year. Students will be able to select a period and then compare what happened during that period among various countries and disciplines. Quizzes will be included in the lesson to measure the students' mastery of the historical periods which they explore.

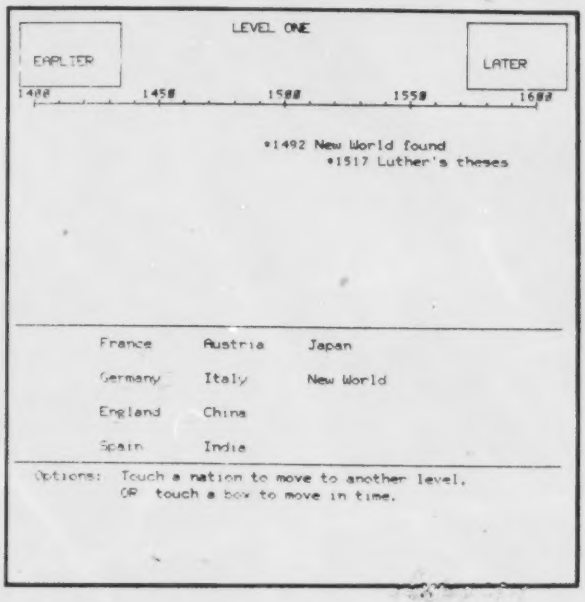


Figure 51. Interactive Timeline, by Brian Hansen. Copyright © 1977 by the University of Delaware PLATO Project.

CHAPTER III. EVALUATION

Because of its developmental nature, the Delaware PLATO Project regularly conducts a rigorous internal evaluation. Student opinions are highly valued and are collected in a systematic manner. Controlled experiments are conducted to test the effectiveness of new lesson materials. Project leaders prepare bi-monthly project reports which are used in monitoring program development throughout the year. And a list of the principal values that PLATO has for the university is maintained. The manner in which these components interact is explained in the model for project evaluation.

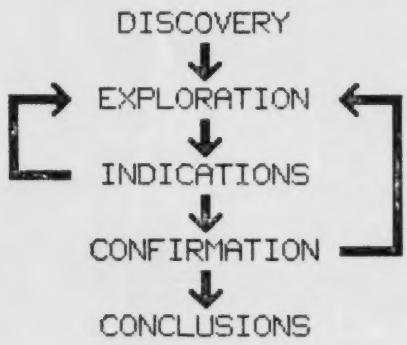
-Model for Project Evaluation-

At our College of Education's recent learning symposium on evaluation, Herbert J. Walberg maintained that the process of inquiry contains five main stages, namely, discovery, exploration, indications, confirmation, and conclusions. Every event in the history of PLATO at our university fits into one of these categories, both at the overall project level and within each individual department. At the project level, PLATO was discovered by our computer assisted instruction committee during the Fall of 1974. The university explored the potential of PLATO during the trial period in the Spring of 1975. Indications were summarized in the report of the Summer of 1975. Confirmation that PLATO has potential for the university was obtained during the 1975-76 and 1976-77 academic years, based on the successful implementation of PLATO in so many departments.

Each department goes through these stages individually when it begins a PLATO project. Discovery usually takes place at one of the periodic PLATO demonstrations, or through a colleague who personally shows his work to a new person. Exploration consists of reviewing existing PLATO lessons, learning about the capabilities of the PLATO system, and reading literature about uses of PLATO. This phase is facilitated by the orientation seminar (above p. 14), the lesson review process, (above, p. 16), and materials in the PLATO library (above, p.12). Indications are discussed and codified in meetings with peers, PLATO staff members and departmental chairpersons. Confirmation is attained through repeated success of the program in its academic environment. Success is measured through administration of student questionnaires, and through controlled studies of educational effectiveness. A continuous cycle of exploration, indications, and confirmation occurs in most departments, as shown in figure 52.

Figure 52

Process of Inquiry in Departments Using PLATO



-Student Questionnaires-

A very important component in the evaluation of the Delaware PLATO Project is the opinion of the students. The instructor of every PLATO course is required to have the students complete a questionnaire. Figure 53 shows a standard questionnaire which is given to each instructor as a model for evaluation of PLATO. The instructor can administer the questionnaire as it stands, or he can change, delete, and add items peculiar to his specific course.

During the 1976-77 academic year the student response to PLATO was very positive. Perhaps the two most representative items concerned whether students felt PLATO was an enjoyable learning experience, and whether they felt PLATO was worth the effort. Overall, 89% of the students felt PLATO was enjoyable, and 86% felt it was worth the effort.

Figure 53

Student Evaluation of PLATO

Course:
Instructor:
Date:

Please answer the following questions about your experiences with the PLATO system and the lessons which you have seen. Your responses will provide valuable information for evaluating and improving PLATO. Thank you for your cooperation.

DIRECTIONS: For the following statements, please check the response closest to your opinion.

1. While working on PLATO, I experienced these feelings:

Fun	☐ Often	☐ Half the time	☐ Seldom
Frustrated	☐ Often	☐ Half the time	☐ Seldom
Challenged	☐ Often	☐ Half the time	☐ Seldom
Annoyed	☐ Often	☐ Half the time	☐ Seldom
Involved	☐ Often	☐ Half the time	☐ Seldom
Confused	☐ Often	☐ Half the time	☐ Seldom
Bored	☐ Often	☐ Half the time	☐ Seldom
Encouraged	☐ Often	☐ Half the time	☐ Seldom
In control	☐ Often	☐ Half the time	☐ Seldom
Successful	☐ Often	☐ Half the time	☐ Seldom

2. Using PLATO was an enjoyable experience ..	☐ Agree	☐ Uncertain	☐ Disagree
3. The mechanics of using the PLATO terminal distracted me from learning	☐ Agree	☐ Uncertain	☐ Disagree
4. The major points of the lessons were made clear	☐ Agree	☐ Uncertain	☐ Disagree
5. I learned what the lesson tried to teach .	☐ Agree	☐ Uncertain	☐ Disagree
6. I already knew the material covered in the lessons	☐ Agree	☐ Uncertain	☐ Disagree
7. The materials presented by PLATO could be presented just as effectively with other audio visual aids	☐ Agree	☐ Uncertain	☐ Disagree
8. The PLATO lessons helped me learn the material more thoroughly than other forms of instruction	☐ Agree	☐ Uncertain	☐ Disagree
9. PLATO helped me learn more efficiently ...	☐ Agree	☐ Uncertain	☐ Disagree
10. A lesson on PLATO is more interesting than traditional instruction	☐ Agree	☐ Uncertain	☐ Disagree
11. In view of the effort I put into it, I was satisfied with what I learned while using PLATO	☐ Agree	☐ Uncertain	☐ Disagree
12. Too much class time was spent using PLATO.	☐ Agree	☐ Uncertain	☐ Disagree

Figure 53 (Continued)

13.	I would like to spend more class time using PLATO	☐ Agree	☐ Uncertain	☐ Disagree
14.	I would like to take another course which uses PLATO	☐ Agree	☐ Uncertain	☐ Disagree
15.	I was able to schedule enough time each week in which to work	☐ Agree	☐ Uncertain	☐ Disagree
16.	I found myself just trying to get through the material rather than trying to learn	☐ Most of the time	☐ Half of the time	☐ Seldom
17.	Most of the time the pace of the lessons was	☐ Too slow	☐ About right	☐ Too fast
18.	Most of the time the work on PLATO was	☐ Too difficult	☐ About right	☐ Too easy

Student comments dealt with a variety of topics. They requested more versatility in signing up for time on PLATO, more terminals, and more programs. They asked that lessons developed at other universities be modified to use Delaware terminologies when different terms are used. They want more exercises to practice in preparation for regular hourly exams. They asked that PLATO be used for a greater percentage of their courses. Students commented about PLATO's patience, stating that they were glad that the computer never gets tired of helping them. The most frequent comment concerned the self-paced, individualized learning format. Students feel that PLATO helps them most by providing individualized, immediate feedback to their answers.

Student opinions are so highly valued that when the overall importance of continuing program development in one of the PLATO departments was being considered, the question of whether to continue it was put to the students who had been using the program in its developmental stage. All of the students were in favor of pursuing the endeavor, and it has been continued.

-Controlled Experiments-

To date, controlled experiments have been done in two departments, namely, music and languages. As their use of PLATO matures, other departments will be encouraged to perform controlled experiments of program effectiveness. Evaluations already planned for the 1977-78 academic year include art, chemistry, reading, and home economics.

In music, an experiment was conducted with the freshman ear-training class in order to determine whether the GUIDO ear-training programs could make a significant impact on student achievement in harmonic dictation. The GUIDO system actually began on the university's B6700 computer. During this experiment the programs were being moved to PLATO in a new format, and students used both the B6700 and PLATO for ear-training practice. Most of the dictation exercises were delivered on the B6700. During the first semester, all thirty-three students in the class received the same course of instruction in ear-training with all drill-and-practice done in the tape laboratory. At the beginning of the second semester, the freshman ear-training class was randomly split into two groups; seventeen students were assigned to an experimental GUIDO group, and sixteen students were assigned to a control TAPE group. One of the TAPE students subsequently withdrew from the class, so that the TAPE group was reduced to fifteen students. Each ear-training student spent an average of two hours per week practicing harmonic dictation. Students in the GUIDO group practiced a set of 198 dictation exercises which were typed into the computer from the Benward (1969) Workbook of Ear-Training and the Horacek-Lefkoff (1970) Programmed Ear-Training series. Students in the TAPE group practiced 281 dictation exercises on the tapes which accompany the same two workbooks. Although students in the TAPE group had 83 more exercises available than students in the GUIDO group, it was assumed that for the purpose of this study the two sets of dictation exercises were basically the same.

Student achievement in harmonic dictation was measured by three tests. The first test was administered at the end of the first semester in order to measure achievement in training in both groups prior to the introduction of GUIDO in the experimental group. The second and third tests were given during the second semester as measures of student achievement in both groups after the introduction of GUIDO in the experimental group. The tests were administered in a classroom situation, and the dictation exercises were played at a piano. All three tests had exactly the same format and were scored as illustrated in Figure 54. The first test covered the triads I, II, IV, V, and VII; the second test, I, II, IV, V, VI, and VII; and the third test, I, II, III, IV, V, VI, and VII. Major and minor keys and triad inversions were included in all three tests.

Figure 54

Test Format and Scoring for the Music Exam

Scoring	Question
Two points for each triad. If the Roman numeral is correct but the inversion is wrong, the answer is considered to be 3/4 correct. Total number of points for this question: 48	1. Each of the following exercises consists of a succession of four diatonic triads. Fill in the blanks with the Roman numeral representation of each triad, including inversions. Each exercise will be played three times. a) ___ ___ ___ ___ b) ___ ___ ___ ___ c) ___ ___ ___ ___ d) ___ ___ ___ ___ e) ___ ___ ___ ___ f) ___ ___ ___ ___
Two points for each triad. If the Roman numeral is correct but the inversion is wrong, the numeral is considered to be 3/4 correct. Each soprano and bass note is worth 1 point. Total number of points for this question: 52	2. Each of the following exercises consists of a succession of seven diatonic triads. Fill in the blanks with the Roman numeral representation of each triad, indicating inversions. In addition, write the soprano and bass lines on the staff. Each exercise will be played four times.

Table 9 contains a summary of the results of the harmonic dictation tests. The mean scores of the two groups were nearly the same on the first test, but on the subsequent tests the means of the GUIDO group were higher.

In order to determine the significance of these differences in test scores, a t-test was used to compare scores of the two groups for each harmonic dictation test. Whereas the scores of the two groups do not differ significantly on the first and second tests, they do differ beyond the .05 level on the third test. Students in the GUIDO group scored higher than students in the TAPE group, indicating that those students using GUIDO's interactive computer program for drill and practice achieved greater harmonic dictation skills than those using the tape laboratory.

Table 8

Comparison of Experimental and Control Group Performance in Music

Student Groups	Test 1 (before GUIDO)			Test 2 (after three weeks of GUIDO)			Test 3 (after seven weeks of GUIDO)		
	Mean	Standard Deviation	t	Mean	Standard Deviation	t	Mean	Standard Deviation	t
GUIDO	77	9.9	N.S.	83	13.3	N.S.	86	12.4	$p<.05$
TAPE	76	11.1		75	16.1		75	14.4	

A similar experiment was conducted in languages. Two sections of an elementary Latin course were used, with one section constituting an experimental PLATO group and the other section a CONTROL group. Both sections met in class for the normal three 50-minute periods per week. The PLATO group spent two additional hours each week at the computer terminals using materials developed by Professor Gerald Culley of our university and by Professor Richard Scanlon at the University of Illinois (above, p. 42). The CONTROL group spent the same amount of time practicing traditional Latin materials.

Student achievement in Latin was measured by four tests. These tests were administered in a classroom situation. The first test covered chapters 1-6 of Frederic Wheelock's Latin: An Introductory Course Based on Ancient Authors (Barnes and Noble, Inc., 1963). The second test covered chapters 7-12. The third test covered chapters 13-18. The fourth test covered the whole semester, chapters 1-25.

Table 10 contains a summary of the results of the Latin tests. The mean scores of the two groups were nearly the same on the first test, but on subsequent tests the means of the PLATO group were higher.

In order to determine the significance of these differences in test scores, a univariate analysis of variance was used to compare the two sets of test scores. The scores of the two groups do not differ significantly ($p < .45$), although a trend can be observed in the PLATO group where the mean was equal to the CONTROL group score on the first test, 6% higher on the second test, 4% higher on the third test, and 4% higher on the fourth test.

Table 9

Comparison of Experimental and Control Group Performance in Latin

Student Groups	Test 1 (August 4)		Test 2 (August 25)		Test 3 (September 17)		Test 4 (September 22)	
	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
PLATO	86	11.0	84	14.4	79	15.6	78	18.5
CONTROL	86	9.1	78	14.8	75	14.6	74	17.3

-Bi-Monthly Project Reports-

Each project leader is required to submit bi-monthly project reports to the director of the PLATO project. These include updates on progress made in the programming of lessons, ideas for the design of new lessons, lists of important PLATO events in the department, proposed plans for quantitative and qualitative evaluations, and recommendations for improving the services offered by the PLATO project. The progress reports constitute the primary written record of the project, and they are kept permanently in the project files.

Through detailed study of these reports, each project is monitored in its formative stages. When specific needs are identified, appropriate actions are taken. These have included consultation with the project leader, meetings of the staff and faculty involved in the project, presentations at research and development seminars, requests for additional personnel, and travel requests for faculty and staff to present papers at conventions, to visit other computer-based learning sites, and to attend training seminars.

-Overall Educational Value of PLATO for the University of Delaware-

As the Delaware PLATO Project has grown from the installation of its first terminal on March 14, 1975 to its present level of thirty-two terminals, and as the number of departments using PLATO has increased from the original three to the present twenty-five, the faculty and students have identified many benefits of PLATO to the University of Delaware. It is through the realization of these benefits that PLATO has received a widespread support and acceptance at the university. This report concludes with the classification of these benefits according to ten main purposes which are enumerated and explained as follows:

1. To individualize instruction. Faculty members and students often complain that the level of instruction is never right for all members in a class. Some are fast learners; others are slow learners. Some drop out because a course is too boring; others drop out because they can't keep up. The individualized, self-paced approach of PLATO has proven to be a remedy for this problem of individual differences.

2. To expand the university's educational market. The market needs a delivery system which can economically deliver instruction over a wide geographical area. Through computer-based techniques, the university can reach more students. For example, if three people in Georgetown wanted to learn Persian, PLATO could teach them whereas a regular course would be cancelled due to small enrollment. This aspect becomes even more important as the learner population is becoming more adult in its make-up.

3. To reduce the time needed for instruction. Computer-based self-paced techniques make it possible for students to finish courses in less than the normal fourteen-week semester. PLATO could allow students to complete their degree ahead of schedule, thereby reducing the cost of instruction to the parent and to the taxpayer.

4. To emphasize the intrinsic joy of learning and deemphasize competition with peers as a motivating force. In the computer-based environment the anxieties associated with the traditional classroom are minimized. The student is free to respond as he wishes without the fear of ridicule from either his peers or his teacher. In such an environment learning is a lot of fun, and motivation is high.

5. To enable students to develop a richer intuitive grasp of complex phenomena through graphic visual representation. Especially applicable to PLATO is the saying that "A picture is worth a thousand words." The ability of PLATO to create interactively a display suited to the student's specific learning needs cannot be overestimated.

6. To provide students with access to a wide range of data for checking out hypotheses. A good example of this benefit is the population dynamics PLATO program. Stored in the computer are up-to-date data on the populations of countries throughout the world. The student is able to set variables which affect the futures of those populations, such as time and extent of famines, and can then see the effects of those variables upon future generations of the populations.

7. To enable the students to learn more of the complexities of phenomena through modeling and simulation. In addition to giving students drill-and-practice and tutorials on various subjects, PLATO can also allow the student to create models and simulate complex phenomena. For example, the student can make electronic circuits, design clothes, compose music, draw pictures, mix chemicals, breed fruit flies, and then study the results of the models and simulations. Such flexibility is not a regular part of education in university courses; it should be.

8. To encourage students to tailor their learning experiences to meet their own objectives. How often do students complain that they did not get what they wanted out of a course? They may have met the instructor's objectives, but they did not meet their own objectives. PLATO can help them do both. For example, in the university's advanced music theory courses, very little time is spent on set theory. However, some students want to explore it in depth. It is a complex analytical system which cannot be learned by the average student by reading a book. Interactive instruction in this area is made available to the students who want it by means of PLATO's set theory program. There are ten hours of instruction available for students who want to learn set theory, including periodic tests which assure the student that he is mastering the material. In this way, students are encouraged to extend their learning beyond the requirements of the course.

9. To give immediate feedback. One of the greatest advantages of computer-based techniques is immediate feedback. Through individual interaction with the computer, each student partakes in a dialogue in which he receives instantaneous responses to his input. There is no other medium which provides this interaction, a benefit which has led to the documentation of significant improvement of instruction in such diverse areas as anesthesiology, French, music, mechanics, dentistry, sociology, calculus, geography, ecology, health, physics, and accounting.

10. To provide maximum flexibility. Micro-electronic technology has progressed to the point at which practically any electronic device can be connected to a PLATO terminal. The terminal already has a slide projector, a touch-sensitive screen, a random-access audio device, a speech synthesizer, and a music generator. The terminal also contains a microprocessor, the latest development in computer hardware, which secures product flexibility for the foreseeable future.

APPENDIX

Catalog of Programs Under Development in the Delaware PLATO Project

CATALOG OF PROGRAMS UNDER DEVELOPMENT IN THE DELAWARE PLATO PROJECT

-Instructional Lessons-

Department	Title	Developer	Programmer(s)
Agriculture	Relations	George Haenlein	Craig Lewis, Dan Tripp
Art	Aesthetic Value Inquiry	Ray Nichols	Joseph Maia
	Composition Using Grey Scale Tones	Ray Nichols	Joseph Maia
	Design Aesthetics and Creation	Ray Nichols	Charles Wickham
	Letter Spacing	Ray Nichols	Charles Wickham
	Newspaper Copy Fitting	Ray Nichols	Joseph Maia
	Rotating Squares Generator	Ray Nichols James Wilson	James Wilson
Counseling	Holland's Self-Directed Search	Richard Sharf Bill Mahler	Bill Mahler Mark Laubach
Education	Big Story (imitative reading)	Peter Pelosi	Jessica Weissman
	Fast Accurate Symbol Transcription for Evaluation of Elementary Reading	John Pikulski	Debbie Braendle
	Metric Estimation Game	Bonnie Seiler James Wilson	Bonnie Seiler James Wilson
	Sight Word Attack Team (SWAT)	Rosalie Bianco Peter Pelosi	Jessica Weissman
	Sight Word Teaching Method Simulations	Peter Pelosi	Jessica Weissman
	SWAT Promotion Test	Rosalie Bianco Peter Pelosi	Jessica Weissman
	Word Zoo (classifying prefixes by meaning)	Steve Hansell	Jessica Weissman
Home Economics	Body Measurement	Fran Smith Fran Mayhew Dottie Elias	Dottie Elias
	Determining Needed Pattern Alterations	Fran Smith Dottie Elias	Dottie Elias James Wilson

Instructional Lessons (Continued)

Department	Title	Developer	Programmer(s)
Home Economics	Ease	Fran Smith Dottie Elias	Dottie Elias
	Metric Visualization	Dottie Elias	Dottie Elias
	Pattern Alteration Simulation	Fran Smith Fran Mayhew Dottie Elias	Dottie Elias James Wilson
	Pattern Measurement	Dottie Elias	Dottie Elias
Languages	Analyzing and Generating Latin Verbs	Gerald R. Culley	Gerald R. Culley
	Review of English Grammar	Gerald R. Culley	Gerald R. Culley
	Substitution Drill and Editor	Dan Williams	Dan Williams
Music	GUIDO Ear-Training System:		
	Intervals	Fred T. Hofstetter	William H. Lynch
	Melodies	Fred T. Hofstetter	William H. Lynch
	Chord Qualities	Rosemary Killam	Michael Larkin
	Harmonies	Fred T. Hofstetter	William H. Lynch
	Rhythms	Fred T. Hofstetter	William H. Lynch
	Fundamentals of Ear-Training	Robert Hogenson	Richard Thomas
	Note Reading Drill and Game	Peter McCarthy	Debbie Braendle
	Set Names (after Forte)	Fred T. Hofstetter	James Trueblood
Nursing	Human Heart Valves (adapted from Illinois vet med lesson)	Shirley Cudney	Charles Wickham
	Simulated Treatment of Diseases	Mary Anne Early	James Trueblood
	Simulation Writer	James Trueblood	James Trueblood
Physics	A Problem in Angular Velocity	Cheng-Ming Fou	Charles Wickham
Theatre	Interactive Timeline	Brian Hansen	Michael Larkin James Wilson

-Research Programs-

Department	Title	Developer	Programmer
Art	Statistical Routine for Evaluating Letter Spacing Assignments	Ray Nichols Charles Wickham	Charles Wickham
Education	A Routine for collecting Multidimensional Scaling Data to Study the Distinctive Features of Various Types of Tabular and Graphical Data Displays	Victor Martuza	James Trueblood
	Sight Word Test Data	Peter Pelosi	Jessica Weissman
Music	Chord Quality Perception Experiment	Rosemary Killam	William H. Lynch
	Melodic Pattern Perception Experiment	Rosemary Killam	William H. Lynch
	Tuning Perception Experiment	Fred Hofstetter Warren Creel	William H. Lynch
	Variation Experiment	Ayleen Burns	James Wilson
Psychology	Memory Research	John McLaughlin	Judy Sandler

-Utilities-

Description	Programmer
Data Transfer Routine: sends data from PLATO to other computers and to cassette tape storage	Charles Wickham
Printing Routines to send information in ASCII, Binary, or octal code to the Diablo Printer	Charles Wickham Joseph Maia
PLATO project resource management and data collection routines	James Wilson
SPSS Formatting Package: Sends response data from PLATO to the Burroughs 7700 for statistical analysis	Charles Wickham
udart: A description of the major art programs developed at the University of Delaware	Ray Nichols
udhelp: How to Use PLATO	Jessica Weissman